California Water and Environmental Modeling Forum

2018 ANNUAL MEETING PROGRAM

California Sustainability of Resources, the Environment & Lifestyle through Modeling

Yolo Bypass – February 23, 2017 (SOURCE: U.S. Fish & Wildlife Service Southwest Region)

ORGANIZATIONAL MEMBERS

California Department of Water Resources

California State Water Resources Control Board

Contra Costa Water District

Delta Stewardship Council

East Bay Municipal Utility District

ICF International

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Metropolitan Water District of Southern California

U.S. Bureau of Reclamation

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OFFICERS

Tariq Kadir, Convener

Shyamal Chowdhury, Vice-Convener

Stacy Tanaka, Treasurer

George Nichols, Secretary

Josué Medellín-Azuara, Past Convener

Paul Hutton, Executive Director

SPECIAL THANKS

To Solano Irrigation District for providing a conference room for Steering Committee meetings.

KEYNOTE ADDRESS

Michael Patrick George, Delta Watermaster
State Water Resources Control Board

Michael Patrick George was appointed to a four-year term as Delta Watermaster beginning in January 2015. The position of Delta Watermaster, created by the 2009 Delta Reform legislation, is an independent officer of the State reporting jointly to the State Water Resources Control Board and the Delta Stewardship Council. The Watermaster has statutory responsibility for administering water rights within the Sacramento/San Joaquin River Delta and the Suisun Marsh. Additionally, the Delta Watermaster advises the Board and the Council on related water rights, water quality and water operations in and affecting the Delta, which is, simultaneously, a critical estuarine habitat, a vital agricultural area, and the hub of California's water infrastructure.

Prior to starting his term, Mr. George was active in western water law and policy as a water lawyer, as the CEO of a publicly traded water resource management company, as a senior executive of an investor owned water company and as an investment banker serving both public and private entities in the water industry. He is an honors graduate of The University of Notre Dame where he was elected to *Phi Beta Kappa* and of the Georgetown University Law Center where he was an editor of *Law and Policy in International Business*. Mr. George has lectured on California water resource issues at the University of California San Diego, the University of Southern California and the University of California at Berkeley. He is a member of the California Bar.

SUMMARY OF SESSIONS

Monday, April 2

Time	Session	Moderator	Room
8:00 - 8:30	Registration		Sierra Hallway
8:30 - 10:15	1. C2VSim Update – Part 1	Ali Taghavi	Sierra 1
	2. Flood Modeling	Samson Haile-Selassie	Folsom/Natoma
10:15 - 10:30	Break		
10:30 - 12:15	3. CalSim 3.0 – Selected Applications	Hongbing Yin	Sierra 1
	4. Temperature Modeling	Mike Deas	Folsom/Natoma
12:15 – 1:00	Lunch - Included in registration fee		Restaurant
1:00 - 2:00	5. CWEMF Awards Ceremony	Josué Medellín-Azuara	Sierra 1
2:00 - 3:15	6. Pop-up Talks – Part 1	Stacy Tanaka & Nigel Quinn	Sierra 1
3:15 - 3:30	Break		
3:30 - 5:15	7. Modeling Runoff, Soil Erosion and Mercury Transport at the Watershed Scale with the Wildfire Effect	Nigel Quinn	Sierra 1
	8. Applications of Multi-Dimensional Models for Examining Water Quality and Flow – Part 1	Aaron Bever	Folsom/Natoma
5:30 - 8:00	9. Business Meeting and Social	Tariq Kadir	Cliff House of Folsom

SUMMARY OF SESSIONS

Tuesday, April 3

Time	Session	Moderator	Room
7:30 - 8:00	Registration		Sierra Hallway
8:00 - 9:45	10. Integrated Water Resources Modeling	Ali Taghavi	Sierra 1
	11. Machine Learning	Sujoy Roy	Folsom/Natoma
9:45 - 10:00	Break		
10:00 - 11:45	12. Grab Bag Session #1: Data, Models, and Tools to Inform Insights and Analysis	Benjamin Bray	Sierra 1
	13. Grab Bag Session #2: River Flows, Controls, Water Quality and Management	Hubert Morel-Seytoux	Folsom/Natoma
11:45 - 12:30	Lunch - Included in registration fee		Restaurant
12:30 - 1:15	14. Keynote Address – Michael George, Delta Watermaster	Tariq Kadir	Sierra 1
1:15 – 3:00	15. Pop-up Talks – Part 2	Jamie Anderson	Sierra 1
	16. Applications of Multi-Dimensional Models for Examining Water Quality and Flow - Part 2	Eli Ateljevich	Folsom/Natoma
3:00 - 3:15	Break		
3:15 - 5:00	17. California Water Plan Update 2018: Envisioning and Tracking California Water Sustainability	Abdul Khan	Sierra 1
	18. ET & Remote Sensing	Jesse Jankowski	Folsom/Natoma
5:00 - 7:00	19. Poster Session and Social *	Stacy Tanaka	Sierra 2

*Posters will be set up by 10:00 am and available for viewing all day. Presenters will be available from 5:00 to 7:00 pm.

SUMMARY OF SESSIONS

Wednesday, April 4

Time	Session	Moderator	Room
7:30 - 8:00	Registration		Sierra Hallway
8:00 - 9:45	20. C2VSim Update – Part 2	Tariq Kadir	Sierra 1
	21. University Engagement on California Water Problems	Josue Medellin-Azuara	Folsom/Natoma
9:45 - 10:00	Break		
10:00 - 11:45	22. Panel Discussion: Using Flood Water for Managed Aquifer Recharge to Support Sustainable Water Resources (Flood MAR)	Samson Haile-Selassie	Sierra 1
	23. DSM2 Update	Nicky Sandhu	Folsom/Natoma
11:45 - 1:15	Lunch at area restaurants		
1:15 - 3:00	24. CalSim and CalLite Model Applications	Chris Quan	Sierra 1
	25. Climate Change	Jamie Anderson	Folsom/Natoma
3:00 - 3:15	Break		
3:15 - 5:00	26. SGMA	Steffen Mehl	Sierra 1
	27. Conjunctive Use Modeling and One-Water (MODFLOW-OWHM) – Examples, Applications and Companion Simulators	Scott Boyce	Folsom/Natoma

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POSTER SESSION

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California Water and Environmental Modeling Forum
Promoting Excellence and Consensus in Water and Environmental Modeling
P.O. Box 5051, Vacaville, CA 95696-5051 (916) 850-3110 cwemf@cwemf.org

Dear CWEMF Membership:

Welcome and thank you all for participating in CWEMF's 24th Annual Meeting. I hope you will find it both informative and an opportunity to touch base with old colleagues and to connect with new ones.

This year's theme is ***California Sustainability of Resources, the Environment, and Lifestyle through Modeling***. Sustainability is generally defined as "meeting the needs of the present without compromising the ability of future generations to meet their needs". It is addressed though studies of economics, society, and the environment. The theme photo (see program cover) of the Yolo Bypass with the Sierra Nevada mountains and the City of Sacramento skyline in the background, exemplifies many of the inter-related factors associated with California water sustainability. This includes source of water (watersheds), water management (flood control and water supply), agriculture (rice fields), urban (skyline), fisheries (juvenile salmon), groundwater (recharge), and wetland and wildlife habitat (bird refuge). Surface water and groundwater resources are not independent from one another, nor are agricultural, urban, and environmental needs. Long term sustainability of water needs within limited water resources present challenges, with no easy answers or straightforward solutions. Studies and assessments of metrics, measurable objectives, uncertainty, risks, and system resiliency, are necessary in the on-going search for potential alternatives and long-term solutions. It requires more scientific dialogue and cooperative efforts across lines defining disciplines and sectors. CWEMF can both contribute to, and promote such discussions. CWEMF has been successful in facilitating dialogue, providing technical training, and engaging in peer reviews with focus more on water. Moving forward, CWEMF welcomes more coordination with scientists, stakeholders, and organizations in other areas such as the biological, fisheries, and ecosystem sectors. This should facilitate more cross-discipline informational and technical discussions towards achieving long term sustainability.

I also encourage members to take a more active role throughout the year including joining and participating in CWEMF's Steering Committee and its various sub-committees. I would like to thank all the sponsors for their generous contributions for funding the lunches, social events, and poster session. Finally, please take some time to participate in the annual meeting's follow up survey; this helps us better prepare for future CWEMF annual meetings.

Sincerely,

Tariq Kadir
CWEMF Convener

CONTENTS

AGENDA

Monday, April 2

8:00 – 8:30 a.m. – Registration in Sierra Hallway

Refreshments sponsored by Hydroprose International Consulting

8:30 – 10:15 a.m.

Session 1. C2VSim Update – Part 1

Moderators: Ali Taghavi (Woodard & Curran)
Location: Sierra 1

1. Status of C2VSim Model Development and Related Tools – Can Dogrul (DWR)

2. Enhancement of California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) – Mesut Cayar (Woodard & Curran)

3. Developing Historical Surface Water Diversion and Delivery Data for the Central Valley – Charlie Brush (UC Davis) and Sara Miller (Woodard & Curran)

4. CVSIM: Linking C2VSim with CVP-SWP Reservoir Operations – Tariq Kadir (DWR)

Session 2. Flood Modeling

Moderator: Samson Haile-Selassie (DWR)
Location: Folsom/Natoma

1. Bypass Capacity Planning with Uncertain Non-Stationary Hydrology – Alessia Siclari (UC Davis)

2. Financial Impacts of Flooding: Uncle Sugar Won't be There to Help Us, Why it's up to Flood Modelers to Save California – Kathleen Schaefer (UC Davis)

3. California Flood Vulnerability Assessment and Adaptation Planning: Bottom-up Approach – Andrew Schwarz (DWR)

4. Lower Elkhorn Basin Levee Setback: Hydrologic and Hydraulic System Performance Analysis – Jeremy Hill (DWR)

5. Sacramento-San Joaquin Delta 100-year Hydrology Modernization Project: The Role of RAS2D Bay-Delta Hydraulic Model – Rummy Sandhu (DWR)

10:30 a.m. – 12:15 p.m.

Session 3. CalSim 3.0 – Selected Applications

Moderator: Hongbing Yin (DWR)
Location: Sierra 1

1. Incorporating DWR Water Rights into CalSim 3.0 to Track SWP Water – Liheng Zhong (DWR)

2. Sacramento Valley Water Use Assessment Using CalSim 3.0 – Richard Chen (DWR)

3. California's Fourth Climate Change Assessment: Mean and Extreme Climate Change Impacts on the State Water Project - Jay (Jianzhong) Wang (DWR)

4. Estimating Effect of Historical Warming on CalSim 3.0 Rim Inflow Hydrology with SWAT - Guobiao Huang (DWR)

5. Historical Temperature Detrending Sensitivity Study – Hongbing Yin (DWR)

Session 4. Temperature Modeling

Moderator: Mike Deas (Watercourse Engineering)
Location: Folsom/Natoma

1. The Origins of the Anomalous Warming in the California Coastal Ocean and San Francisco Bay during 2014–2016 – Yi Chao (UCLA)

2. Water Temperature Model Development – Modeling Technical Committee for Shasta Lake and Keswick Reservoir: An Example of a Collaborative Modeling Approach – Randi Field (USBR)

3. Shasta Lake and Keswick Reservoir Water Temperature Modeling with CE-QUAL-W2 – Mike Deas (Watercourse Engineering)

4. Folsom Reservoir and Lower American River Water Temperature Modeling – R. Craig Addley and Vanessa Martinez (Cardno Entrix)

12:15 – 1:00 p.m.

Lunch

Pick up a box lunch and then join us for the CWEMF Awards Ceremony in Sierra 1.

Lunch sponsored by CBEC Eco Engineering and Larry Walker & Associates

1:00 – 2:00 p.m.

Session 5. CWEMF Awards Ceremony

Moderator: Josué Medellín-Azuara (CWEMF/EBMUD)
Location: Sierra 1

Presentation of the Hugo B. Fischer, Career Achievement, and Distinguished Life Membership awards.

2:00 – 3:15 p.m.

Session 6. Pop-up Talks – Part 1

Moderators: Stacy Tanaka (Watercourse Engineering) and Nigel Quinn (Berkeley National Laboratory/Reclamation)
Location: Sierra 1

Five-minute overviews summarizing modeling work using a maximum of five PowerPoint slides per speaker.

3:30 – 5:15 p.m.

Session 7. Modeling Runoff, Soil Erosion and Mercury Transport at the Watershed Scale with the Wildfire Effect

Moderator: Nigel Quinn (Lawrence Berkeley National Laboratory/Reclamation)
Location: Sierra 1

1. Session Overview – Nigel Quinn (LBL/USBR)

2. Post-fire Runoff Modeling at the Watershed Scale – Jun Wang (USBR)

3. Modeling Soil Erosion and Sediment Transport at the Watershed Scale – Yong Lai (USBR)

4. Modeling the Effects of Wildfire on Mercury and Methylmercury Transport at the Watershed Scale – Charles Alpers (USGS)

3:30 – 5:15 p.m.

Session 8. Applications of Multi-D Models for Examining Water Quality and Flow – Part 1

Moderator: Aaron Bever (Anchor QEA)
Location: Folsom/Natoma

1. Water Quality Modeling of Loch Lomond Reservoir with CE-QUAL-W2 – Merve Gorguner (Watercourse Engineering)

2. Current Status of the SCHISM-CoSiNE Model in San Francisco Bay – Richard Dugdale (Romberg Tiburon Center, San Francisco State University)

3. Evaluation of Sediment Supplementation to the Lower Sacramento River to Increase Turbidity in the Low Salinity Zone – Aaron Bever (Anchor QEA)

4. SCHISM Bay-Delta Modeling Study for Franks Tract Restoration Feasibility Study – Kijin Nam (DWR)

5:30 – 8:00 p.m.

Session 9. Business Meeting and Social

Moderator: Tariq Kadir (CWEMF/DWR)
Location: Cliff House of Folsom

Social sponsored by MBK, Resource Management Associates, Jacobs and S.S. Papadopulos & Associates (SSP&A)

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE IF YOU WILL NOT BE COMING BACK TO THE ANNUAL MEETING.

AGENDA

Tuesday, April 3

7:30 – 8:00 a.m. – Registration in Sierra Hallway

Refreshments sponsored by Pacific Agroecology LLC

8:00 – 9:45 a.m.

Session 10. Integrated Water Resources Modeling

Moderator: Ali Taghavi (Woodard & Curran)
Location: Sierra 1

1. Statewide Evaluation of "No Overdraft Policy" with a Hydroeconomic Model, CALVIN – Mustafa Dogan (UC Davis)

2. Estimating Subregional Outflow Adjustments using ANN to Improve C2VSim Simulations – Tariq Kadir (DWR)

3. Sacramento Valley Simulation Model - SVSim: Advances in the Simulation of Stream Depletion Caused by Groundwater Pumping in the Sacramento Valley – Linda Bond (DWR)

4. Central Coast Hydrologic Region Pilot: Water Budget and Multi-Cropping – Paul Shipman (DWR), Frank Qian (Woodard & Curran), and Julie Hass (DWR)

Session 11. Machine Learning

Moderator: Sujoy Roy (Tetra Tech)
Location: Folsom/Natoma

1. Precipitation Estimation from Satellites using Machine Learning Methods – Kuolin Hsu (UC Irvine)

2. Prediction of the Surface Runoff Quality Using Machine Learning and Deep Learning Methods – Jing Liang (UC Riverside)

3. A Hybrid Boosted Regression Tree Model to Predict and Visualize Nitrate Concentration Throughout the Central Valley Aquifer – Katherine Ransom (UC Davis)

4. A Hybrid Empirical-Bayesian Artificial Neural Network Model of Delta Salinity – John Rath (Tetra Tech)

10:00 – 11:45 a.m.

Session 12. Grab Bag Session #1: Data, Models, and Tools to Inform Insights and Analysis

Moderator: Benjamin Bray (EBMUD)
Location: Sierra 1

1. Visualization and Calibration of IWFM Applications in 3D using GroundWater Desktop – Marinko Karanovic (S.S. Papadopulos & Associates, Inc.)

2. Forecasting ET Demand: Klamath Secure Reservoir Ops Pilot Project – Zackary Leady (USBR)

3. Hydraulic Model Analysis near the Confluence of Lower Feather River and Sutter Bypass – Sungho Lee (Central Valley Flood Protection Board)

4. Multivariate Drought Risk Atlas for Sacramento Valley for Future Climate Scenarios – Deepthi Rajsekhar (DWR)

Session 13. Grab Bag Session #2: River Flows, Controls, Water Quality and Management

Moderator: Hubert Morel Seytoux (Hydroprose International Consulting)
Location: Folsom/Natoma

1. Effects of Stormwater Capture and Use on Urban Streamflows – Erik Porse (CSU Sacramento)

2. Delta Outflow & Salinity: Trends and Change Attribution – Paul Hutton (Tetra Tech)

3. Drought Stress Tests for Water Supply: Residential Well Impacts and Economic Externalities – Robert Galey (UC Davis)

4. How to Live with No Regrets: Informing Policy Decisions through Marginal Economic Analysis of Water Supply and Demand Management Actions under Uncertainty – Alvar Escriva-Bou (PPIC)

11:45 a.m. – 12:30 p.m.

Lunch

Pick up a box lunch and then join us for the keynote address by Michael George.

Lunch sponsored by Hydroprose International Consulting

12:30 – 1:15 p.m.

Session 14. Keynote Address

Moderator: Josué Medellín-Azuara (CWEMF/UC Merced)
Location: Sierra 1

Michael George, Delta Watermaster

1:15 – 3:00 p.m.

Session 15. Pop-Up Talks – Part 2

Moderator: Jamie Anderson (DWR)
Location: Sierra 1

Five-minute overviews summarizing modeling work using a maximum of five PowerPoint slides per speaker.

Session 16. Applications of Multi-D Models for Examining Water Quality and Flow – Part 2

Moderator: Eli Ateljevich (DWR)
Location: Folsom/Natoma

1. Hydraulic Modeling to Estimate Proportional Water Sources to the Lower Sacramento River – Lisa Thompson (Sacramento Regional County Sanitation District)

2. Improving System Wide Flood Intelligence on the Sacramento River System using Forecast NWS Data – MD Haque (DWR)

3. Transport Between Ponds, Sloughs and the Open Bay: Hydrodynamics in Lower South Bay – Rusty Holleman (SFEI)

4. Modeling Water Age in the Upper San Francisco Estuary – Ed Gross (RMA)

3:15 – 5:00 p.m.

Session 17. California Water Plan Update 2018: Envisioning and Tracking California Water Sustainability

Moderator: Abdul Khan (DWR)
Location: Sierra 1

1. California Water Plan 2018 – Outcome-Based Planning for Better Policy Decisions – Paul Massera (DWR)

2. Water Budget Development Practitioner's Handbook – Todd Hillaire (DWR), Abdul Khan (DWR), and Saquib Najmus (Woodard & Curran)

3. California Water Plan Update 2018 Water Balance Data and Tools – Jennifer Kofoid (DWR)

4. Development of the California Regional Water Management Atlas – Lew Moeller (DWR)

5. AB 1755 The Open and Transparent Water Data Act: Putting Data to Work – Chris McCready and Matt Correa (DWR)

Session 18. ET & Remote Sensing

Moderator: Jesse Jankowski (UC Davis)
Location: Folsom/Natoma

1. Applications of CalETa in Water Resources Management – George Paul (Formation Environmental LLC)

2. A Comparative Study for Estimating Crop Evapotranspiration in the Sacramento-San Joaquin Delta – Josué Medellín-Azuara (UC Merced)

3. Estimating the Impact of Land Use Change on Delta Consumptive Use using DETAW v2.0 – Lan Liang (DWR)

4. Google Earth Engine METRIC (GEM) Application for Remote Sensing of Evapotranspiration – Nicholas Santos (UC Davis)

5. Mapping Evapotranspiration in the Sacramento-San Joaquin Delta using Simulated ECOSTRESS Thermal Data: Validation and Inter-Comparison – Andy Wong (UC Davis)

5:00 – 7:00 p.m.

Session 19. Poster Session and Social

Moderator: Stacy Tanaka (Watercourse Engineering)
Location: Sierra 2

Poster session sponsored by Watercourse Engineering

Social sponsored by ICF, Tetra Tech, and Woodard & Curran

Poster Session Titles

1. Real-time Ensemble Flow Forecasts for a 2017 Mock Operation Test Trial of Forecast Informed Reservoir Operations for Lake Mendocino in Mendocino County, California – Chris Delaney (Sonoma County Water Agency)

2. Projected Changes in Precipitation, Temperature, and Drought across California's Hydrologic Regions in the 21st Century – Minxue (Kevin) He (DWR)

3. Climate Change Impacts on Central Valley and San Francisco Bay-Delta Estuary Flows – Minxue (Kevin) He (DWR)

4. A Comparative Study of Consumptive Water Use in the Sacramento-San Joaquin Delta – Jesse Jankowski (UC Davis)

5. Visualization and Calibration of IWFM Applications in 3D using GroundwaterDesktop – Marinko Karanovic (SSP&A)

6. Evapotranspiration Estimation from Unmanned Aerial Vehicle Imagery – Jorge Andres Morande (UC Davis)

7. Interpretation and Implementation of the 1969 Colorado Water Law and its Relevance to the 2014 Sustainable Groundwater Management Act – Hubert Morel-Seytoux (Hydroprose International Consulting)

8. Accurate and Efficient Modeling of Alternating Sequences of Saturated and Unsaturated Seepage – Hubert Morel-Seytoux (Hydroprose International Consulting)

9. Data Needs for Using Water Quality Models to Establish Nutrient Goals – Tad Slawecki (LimnoTech)

10. Calibration of a Hydrologic Model Using Spatially Distributed Evapotranspiration – Mohammad Sohrabi (UC Merced)

11. Complex Cascading Dam Breach Analysis using HEC-RAS 2D – Eric Toth (EBMUD)

12. Master Middle Ware: A Tool to Integrate Water Resources and Fish Population Dynamics Models – Sooyeon Yi (UC Berkeley) and Lisa Thompson (Sacramento Regional County Sanitation District)

13. Modeling Nitrogen Cycling in Suisun Bay and Delta – Zhenlin Zhang (SFEI)

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE IF YOU WILL NOT BE COMING BACK TOMORROW.

AGENDA

Wednesday, April 4

7:30 – 8:00 a.m. – Registration in Sierra Hallway

Refreshments sponsored by LimnoTech

8:00 – 9:45 a.m.

Session 20. C2VSim Update – Part 2

Moderator: Tariq Kadir (DWR)
Location: Sierra 1

1. Land Use Development for the C2VSim Update – Tyler Hatch (DWR)

2. Application of IDC for Water Management in California, including Updates of C2VSim – Byron Clark (Davids Engineering) and Dominick Amador (Woodard & Curran)

3. Use of Automated Calibration with IWFM-IDC Models: Examples from C2VSim and SVSim Applications – Matt Tonkin and Vivek Bedekar (S.S. Papadopulos & Associates)

4. Application of C2VSim for Groundwater Sustainability Analysis and GSP Development Support – Ali Taghavi (Woodard & Curran)

Session 21. University Engagement on California Water Problems

Moderator: Josué Medellín-Azuara (UC Merced)
Location: Folsom/Natoma

Panelists: Jay R. Lund (Professor, UC Davis); Tina Leahy (Legal Counsel, Waterboards); Tara Smith (Chief, Modeling Support Branch, DWR)

In this session, we bring in academics and agency officials to discuss the potential of universities and research centers to producing research to better inform water and environmental management and policy decisions. The first component in the session includes four flash presentations by graduate students from various universities (UC Davis, CSU Sacramento and UC Merced). Second, the panel provides opening statements, how university and modeling of environmental systems in general can better inform management and policy decisions. The moderator will then provide questions related to the student presentations and will take questions from the audience for the panelists and the presenters. Concluding remarks will be offered at the end of the session.

1. Calibration of a Hydrologic Model Using Spatially Distributed Evapotranspiration – Mohammad Sohrabi (UC Merced)

2. Davis Manor Green Infrastructure Modeling – John Heltzel (CSU Sacramento)

3. Policy Insights from Comparing Evapotranspiration Estimates in the Sacramento-San Joaquin Delta – Jesse Jankowski (UC Davis)

4. Random is not Unbiased: Rethinking Cross Validation Strategies – Ellie White (UC Davis)

10:00 – 11:45 a.m.

Session 22. Panel Discussion: Using Flood Water for Managed Aquifer Recharge to Support Sustainable Water Resources (Flood MAR)

Moderator: Amy Bindra (DWR)
Location: Sierra 1

Panelists: Jon Fenske (Senior Hydraulic Engineer, Hydrologic Engineering Center); Helen Dahlke (Assistant Professor, UC Davis); Romain Maendly (Senior Water Resources Engineer, DWR); Daniel Mountjoy, (Director of Resource Stewardship, Sustainable Conservation)

The recent cycle of multi-year drought followed by a wet year and flooding, and the passage of Sustainable Groundwater Management Act, has provided a unique opportunity to discuss and inform long-term State policies related to flood management and groundwater management. The California Department of Water Resources, and other State, federal, regional, and local entities, are actively exploring opportunities to determine how flood management, land use, and groundwater management can be integrated to their mutual benefit. Flood-MAR is an integrated resources management strategy that uses flood water resulting for groundwater recharge on agricultural lands and working landscapes. In this session, panelists will present and discuss models and tools to estimate managed recharge from the flood waters, field application results, the research and data development framework for Flood-MAR, and local interests in capturing flood flows through a variety of recharge methods.

Session 23. DSM2 Update

Moderator: Nicky Sandhu (DWR)
Location: Folsom/Natoma

1. Martinez EC Estimation with DSM2-Extended Grid – Ines Ferreira (DWR)

2. DSM2 Sediment Transport Model (DSM2-STM) Development – En-Ching Hsu and Jamie Anderson (DWR)

3. Delta Channel Depletion Model – Lan Liang and Bob Suits (DWR)

4. Suisun Marsh Salinity Control Gate Re-Operation Study Using DSM2 – Yu (Joey) Zhou and Minxue (Kevin) He (DWR)

11:45 a.m. – 1:15 p.m.

Lunch at area restaurants

1:15 – 3:00 p.m.

Session 24. CalSim and CalLite Applications

Moderator: Chris Quan (DWR)
Location: Sierra 1

1. Reclamation Updates to CalSim-II – Nancy Parker (USBR)

2. San Joaquin Hydrology and the Fully-Connected Sacramento-San Joaquin CalSim 3.0 Model – James Gilbert (USBR)

3. CalSim and Tableau: Decision Support Through Visual Analytics – Karandev Singh and Nur Taraky (DWR)

Session 25. Climate Change

Moderator: Jamie Anderson (DWR)
Location: Folsom/Natoma

1. Projected Changes in Runoff of California's Major Water Supply Watersheds in the 21st Century – Minxue (Kevin) He (DWR)

2. Ensemble Flow Forecasts for Risk Based Reservoir Operations of Lake Mendocino: An Adaptive Approach to Reservoir Management – Chris Delaney (Sonoma County Water Agency)

3. The Governance Gap: Climate Adaptation and Sea Level Rise in the San Francisco Bay Area – Mark Lubell (UC Davis)

4. The Role of Modeling in California's Fourth Climate Change Assessment – Jamie Anderson (DWR)

3:15 – 5:00 p.m.

Session 26. SGMA

Moderator: Steffen Mehl (Cal State Chico)
Location: Sierra 1

1. SGMA Technical Assistance and Climate Change Guidance - Steven Springhorn and Tyler Hatch (DWR)

2. Groundwater Models as a Tool to Support Sustainable Groundwater Management in a Basin with Strong River-Aquifer Interactions - Laura Foglia (UC Davis)

3. GSP Development from the Butte County Perspective - Christina Buck (Butte County Water and Resource Conservation)

4. Groundwater Quantity and Quality Model Developed as a Salt and Nitrate Management Analysis Tool for a Management Zone in California's Eastern Kings Subbasin - Mohamed Nassar (Luhdorff & Scalmanini)

Session 27. Conjunctive Use Modeling and One-Water (MODFLOW-OWHM) – Examples, Applications and Companion Simulators

Moderator: Scott Boyce (USGS)
Location: Folsom/Natoma

1. Introduction to Session and One-Water Overview – Scott Boyce (USGS)

2. Salinity Demand and Reservoir Operations in the Second Version of One Water Hydrologic Flow Model – Randall Hanson (One-Water Hydrologic)

3. Using a Pesticide Database to Estimate Multi-Cropped Land Use – Wes Henson (USGS)

4. Using the Basin Characterization Model to Develop Hydrologic Boundary Conditions for One Water Hydrologic Models – Dina Saleh (USGS)

5. An Update to the Central Valley Hydrologic Model: A Regional Tool to Evaluate Sustainable Groundwater Management – Claudia Faunt (USGS)

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE.

ABSTRACTS[1]

Session 1. C2VSim Update – Part 1

1. Status of C2VSim Model Development and Related Tools

Presenter(s): Emin Can Dogrul (California Department of Water Resources)
Presenter(s) Email Address(es): Can.Dogrul@water.ca.gov
Collaborators: DWR staff, Woodard & Curran, Davids Engineering, SSPA
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
California Department of Water Resources, with the help of several collaborators, has been updating and calibrating the fine and coarse grid versions of the C2VSim model, namely C2VSim-FG and C2VSim-CG. C2VSim-FG is expected to be a valuable tool for Groundwater Sustainability Agencies in the development of their Sustainability Plans in compliance with SGMA, while C2VSim-CG is expected to be used for high-level analysis. Both models have been migrated to the latest version of the IWFM-2015 numerical engine and the simulation period extended to September 2015. Water demand and land surface flow processes in both models are now simulated at each grid cell. Surface water diversions are delivered to groups of cells representing the boundaries of agencies receiving these deliveries. Number of agricultural crops has been increased to 20 crops which are also used in DWR's Water Plan Updates. Rice and refuge operations are simulated explicitly. To support this setup, soils data, monthly precipitation and evapotranspiration, and annual crop acreages for each cell have been developed for the entire simulation period. The models support new output including zone budget information for groundwater, land surface and root zone processes, and the unsaturated zone allowing full water budget analysis at any sub-domain. Several visualization and analysis tools have also been either developed or in the process of being developed. These include Water Budget Dashboard (currently for Tulare Basin only), IWFM Tools Add-in for Excel to quickly import water budget data into Excel and IWFM GUI for ArcGIS.

2. Enhancement of California Central Valley Groundwater-Surface Water Simulation Model (C2VSim)

Presenter(s): Mesut Cayar
Presenter(s) Email Address(es): mcayar@woodardcurran.com
Collaborators: Tariq Kadir, Abdul Khan, Tyler Hatch, Ali Taghavi, Dominick Amador
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) is currently being refined and enhanced. The model modifications include completing the finite element grid and stream network, which includes developing data from original sources for the fine-grid nodes, elements, streams and lakes (lake elements, element properties, stream properties, land use data, and delineating small-stream watersheds and their surface water flow discharge networks), developing a geologic framework and refining the fine-grid model aquifer stratigraphy, developing and extending hydrology data (precipitation, evapotranspiration, stream inflows, surface water diversions, land use, agricultural crop acreages, urban water demands, etc.) for the fine-grid model

[1] Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

through 2015 from original data sources, evaluating the performance of the fine-grid model, model calibration, and preparing model documentation.

The enhanced C2VSim model can be used for statewide and local analysis of groundwater sustainability in Central Valley. The model can also be used to evaluate current and future water management and planning conditions at Central Valley and/or regional levels, such as:

- Evaluation of impact of conjunctive use programs
- Analysis of effects of water transfer programs on rivers-aquifers interactions
- Assessment of hydrologic impact of climate change scenarios
- Evaluation of water supply analysis in conjunction with CalSim 3
- Evaluation of effects of reservoir re-operations on groundwater supplies
- Evaluation of hydro-economic impacts of various water management scenarios
- Supporting the California Water Plan's Water Portfolio Analysis

3. Developing Historical Surface Water Diversion and Delivery Data for the Central Valley
Presenter(s): Charles Brush and Sara Miller
Presenter(s) Email Address(es): cfbrush@ucdavis.edu, smiller@woodardcurran.com
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Department of Water Resources is developing three integrated hydrologic models of the Central Valley, two grid sizes of the California Central Valley Groundwater-Surface Water Simulation Model (coarse grid and fine grid, respectively C2VSim-CG and C2VSim-FG) and the Sacramento Valley Groundwater-Surface Water Simulation Model (SVSim). Historical monthly surface water diversion and delivery data were compiled for water years 1922-2015 for use in these three models and in support of other water budgeting programs. To fully utilize the refined grid scale and distribution of land use and other data, diversions were specified for individual or small groups of water districts or surface water users. Delivery data for the Sacramento and San Joaquin Groundwater Basins were organized by CalSim3 demand units. Delivery data for the Tulare Basin were organized by water delivery agencies. Individual diversions were each linked to a land use class and a group of model elements in each of the three models. All three models use the same parameters and time series data, with differences due only to variations in model and subregion boundaries. This ensures that all three models are consistent with regards to water budget reporting of surface water diversion data.

4. CVSIM: Linking C2VSIM with CVP-SWP Reservoir Operations
Presenter(s): Tariq Kadir
Presenter(s) Email Address(es): Tariq.Kadir@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
This presentation describes recently completed research work on a new tool CVSIM linking C2VSIM with selected CVP & SWP reservoirs and their operations (using WRIMS). The driving principle of this integration is that the hydrological components affecting the surface water system routing such as land use based water demands, precipitation runoff, stream-aquifer interaction, and return flow are computed by C2VSIM, and passed on to the systems (reservoir operation) model which computes the reservoir releases, allocations (surface water diversions and groundwater pumping), and meeting

operational criteria such as minimum instream flow requirements, Delta outflow requirements, project exports, etc. Another key feature of the integrated tool -subject of a separate presentation in another session- is inclusion of a module in C2VSIM that uses ANN to dynamically simulate the closure term of sub-regional outflows as a function of fourteen variables computed within C2VSIM. Results of application to a global warming study and a conjunctive use study in the Sacramento Valley will also be presented.

Session 2. Flood Modeling

1. Bypass Capacity Planning with Uncertain Non-stationary Hydrology
Presenter(s): Alessia Siclari (UC Davis)
Presenter(s) Email Address(es): asiclari@ucdavis.edu
Collaborators: Rui Hui, Jay R. Lund (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Large floods can damage flood-prone areas, by overtopping river channels or structural failure. Flood bypasses can efficiently reduce flood risks, accommodating excessive river flow. Climate change, with changes in patterns of temperatures and precipitation, is affecting California's flood management. Climate change might worsen regional flooding problems, while economic growth and urbanization of floodplains will increase potential damages. The long-term floodplain management challenge is to be able to balance increasing flood damages and benefits from using floodplains over periods.

Present planning for flood bypass needs analysis for the range of likely evolving future conditions. This study examines climate change effect on optimal bypass capacity using benefit-cost and risk analysis. The problem is formulated as an economic optimization model solved using dynamic programming. This analysis examines how flood management can adapt to flood frequency changes, and how bypass capacity changes can help reduce damages over time. The model developed is applied to the Sacramento River, and the Yolo Bypass. The model suggests promising structural modifications to the bypass. Results are driven by assumptions on the variability of trends in flood frequency.

2. Financial Impacts of Flooding: Uncle Sugar Will Not Be There to Help Us, Why It's Up to You to Save California from the Next Flood Disaster
Presenter(s): Kathleen Schaefer, P.E., CFM
Presenter(s) Email Address(es): kkschaefer@ucdavis.edu
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The federal government has two programs designed to help residents meet their housing needs after a disaster: The Individual Housing Program (IHP) and the National Flood Insurance Program(NFIP). Since 2006, the IHP program has provided more than $4 billion in housing assistance to more than 900,000 households; of these, five households have been in California. The average IHP payout has been roughly $4500, the average NFIP payout has been roughly $8000. All of which suggest that neither program meets the post-flood disaster needs of California residents.

Both the Central Valley Flood Protection Plan and the State Water Plan propose examining a California based flood insurance program. Detailed flood modeling that accurately estimates the average annualized losses (AAL) is a key component to any flood insurance program. This presentation will cover

the methodology for pricing flood risk, the role of the Exceedance Probability Curve (EP), the differences between the NFIP method of pricing risk and that of the private sector, and the key role that accurate modeling can play in the decision-making process. It will present an overview of bad modeling habits that have been promulgated by the FEMA methodology. Lastly, findings on key factors for a successful state led program will be presented.

3. California Flood Vulnerability Assessment and Adaptation Planning: Bottom-up Approach
Presenter(s): Andrew Schwarz (CA Department of Water Resources)
Presenter(s) Email Address(es): Andrew.Schwarz@water.ca.gov
Collaborators: John Kucharski (Hydrologic Engineering Center, Institute of Water Resources, Davis, CA), Mahesh Gautam (CA Department of Water Resources), and Romain Maendly (CA Department of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: YES
Abstract:
The presentation will describe a systematic framework of analysis for the assessment of hydrologic vulnerability and adaptive planning in California. The project – a joint effort between DWR and USACE – aims to develop and recommended approach for quantifying deep uncertainties in flood risk assessment including those associated with atmospheric rivers and climate change, which can be incorporated into the USACE and DWR decision making processes and to inform 2022 CVFPP Update. The presentation will describe the analytic framework of the study (the bottom-up vulnerability assessment and decision scaling techniques), the models and modeling approach, and the ongoing pilot project.

4. Lower Elkhorn Basin Levee Setback: Hydrologic and Hydraulic System Performance Analysis
Presenter(s): Jeremy Hill, P.E. (DWR)
Presenter(s) Email Address(es): Jeremy.Hill@water.ca.gov
Collaborators: David Arrate (DWR), Shem Stygar (DWR), Yiguo Liang (DWR), Rajmani Subedi (DWR), Ricky Doung (DWR), Mahesh Gautam (DWR), Laurence Sanati (DWR), Nathan Pingel (David Ford Consulting Engineers)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Lower Elkhorn Basin Levee Setback is being designed to reduce flood risk in urban and non-urban areas along the Lower Sacramento River. The existing levee is a part of the US Army Corps of Engineers' (USACE) Sacramento River Flood Control Project and therefore requires a Section 408 permit to modify. To obtain the permit, DWR is performing a system performance analysis to show that the project won't create any significant adverse impacts elsewhere is the system. The analysis follows USACE guidance and uses products and tools developed from the Central Valley Hydrology Study (CVHS), Central Valley Floodplain Evaluation and Delineation (CVFED) project, and 2017 Central Valley Flood Protection Plan (CVFPP). This was the first Section 408 project to use the CVHS products and tools. In addition to the risk assessment, other hydrologic and hydraulic analyses were performed to support the levee design and environmental permitting, including: erosion analysis, wave runup assessment, and an interior drainage study.

5. Sacramento-San Joaquin Delta 100-year Hydrology Modernization Project: The Role of RAS2D Bay-Delta Hydraulic Model
Presenter(s): Rummy Sandhu, P.E. (DWR)
Presenter(s) Email Address(es): Shivcharan.Sandhu@water.ca.gov

Collaborators: Ricky Doung (DWR), Rajmani Subedi (DWR), Mahesh Gautam (DWR), Yiguo Liang (DWR), Nathan Van Emmerik (DWR), Shukurat Sanni (DWR), Joel Dudas (DWR), Lori Schultz (USACE), Saba Siddiqui (USACE), Peter Blodgett (USACE)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The presentation discusses the background to the development of Bay-Delta HEC RAS 1D-2D hydraulic model, model extents, data availability and priority, modeling approach, the challenges faced, model development status, and future use of the model once developed. The US Army Corps of Engineers' (USACE) and CA Department of Water Resources (DWR) have collaborated to revise the 1992 Sacramento-San Joaquin Delta California special study. The goals of the project are to develop stage-frequency curves and generate 1% annual chance exceedance water surface profiles for the Delta reaches. As available observed gage records are not sufficient to achieve these goals, USACE and CA DWR have devised best modeling approach to extend stage frequency curves by developing HEC RAS 1D-2D bay-delta hydraulic model.

Session 3. CalSim 3.0 – Selected Applications

1. Incorporating DWR Water Rights into CalSim 3.0 to Track SWP Water

Presenter(s): Liheng Zhong (California Department of Water Resources)
Presenter(s) Email Address(es): Liheng.Zhong@water.ca.gov
Collaborators: Zhiqiang Chen, Hongbing Yin, Erik Reyes, and Francis Chung (California Department of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Due to the complexity of the water system in the Sacramento Valley, it is difficult to precisely keep track of water diverted and distributed under individual water rights. The lack of information and advanced modeling studies poses a challenge to water right holders, project managers and system administrators in the assessment, allocation, and accounting of water resources especially under drought conditions. In this study, CalSim 3.0 was used as the base model and additional detailed codes on DWR water rights were developed as an experiment to trace water stored and delivered by the State Water Project (SWP). Water diverted by Feather River settlement contractors, Table A contractors, and wildlife refuges were explicitly separated as previously-stored SWP water, directly-diverted SWP water, natural flow, and other sources. The SWP component in Delta inflow was quantified. The results demonstrate the dynamic of water related to DWR water rights and SWP contracts in a complex system of water rights and contracts with different priorities. The study shows the possibility of modeling individual water rights in CalSim 3.0, which provides a powerful framework including land use based demand, rainfall-runoff, rim inflow, groundwater interaction, return flow, project operations, weight-based priority, etc. The ongoing effort will continue implementing water rights in CalSim 3.0 to improve the capability of modeling allocation and alleviating drought risks.

2. Sacramento Valley Water Use Assessment Using CalSim 3.0

Presenter(s): Richard (ZhiQiang) Chen (California Department of Water Resources)
Presenter(s) Email Address(es): ZhiQiang.Chen@water.ca.gov
Collaborators: Hongbing Yin, Mei Lui, Liheng Zhong, Jianzhong Wang, and Can Dogrul (California Department of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

A CalSim 3.0 study is conducted in order to analyze water uses in Sacramento Valley under current land use conditions and the historical climate of October 1921 to September 2015. Agriculture water use, urban water use, and refuge water use are simulated by a suite of CalSim 3 hydrology modules. Rainfall runoff, soil moisture condition, evapotranspiration, deep percolation, groundwater aquifer condition, conjunctive uses of both surface water and groundwater, and other hydrologic processes are also simulated. In CalSim 3.0, aquifers underneath the Sacramento Valley are divided into 3 layers with about 500 groundwater elements in each layer, and the valley floor surface is delineated into 145 demand units (DUs) in 30 water budget areas (WBAs). The WBA results of surface water diversion, groundwater pumping and other Sacramento Valley hydrological conditions in both wet and drought periods will be presented.

3. California's Fourth Climate Change Assessment: Mean and Extreme Climate Change Impacts on the State Water Project

Presenter(s): Jay (Jianzhong) Wang (California Department of Water Resources)
Presenter(s) Email Address(es): wangj@water.ca.gov
Collaborators: Hongbing Yin, Erik Reyes, Tara Smith, and Francis Chung (California Department of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
This study uses the California Department of Water Resources' (DWR's) newly developed water planning model, CalSim 3.0, as a risk assessment tool. The study also incorporates 20 Climate Change Technical Advisory Group (CCTAG)-selected climate model projections (10 climate models, and two emission scenarios, representative concentration pathway (RCP) 4.5 and RCP 8.5) into CalSim 3.0. It estimates the following climate change risk factors in the State Water Project (SWP) and Central Valley Project (CVP) for the middle of this century under the ensemble mean condition and the driest climate model projection. The results found that (1) Delta exports would be reduced by at least 10 percent (approximately 500 taf); (2) North of Delta carryover storage would decrease by at least 23 percent (approximately 1,500 taf); (3) Dead storage months would increase by 420 percent, resulting in reliability reduced by 12 percent; (4) Delta salinity would worsen for an entire year when X2 extends eastward as much as 4.5 kilometers.

During drought episodes in the middle of this century, climate change impacts on SWP and CVP operations are much worse in the driest climate model projection scenario in that (1) Delta exports would reduce to half of that in historical droughts; (2) carryover storage would decrease to one-fifth of that in historical droughts.

A series of sensitivity tests were implemented to assess individual impacts of four climate change factors: flow seasonal pattern shift, sea level rise, annual flow volume change, and water demand change on the SWP and CVP operations. Results showed that flow seasonal pattern shift is a major factor to cause Delta export reduction (44 percent) and carryover storage decrease (75 percent) in the middle of this century. Sea level rise is a secondary factor for Delta export deduction (35 percent).

4. Estimating Effect of Historical Warming on CalSim 3.0 Rim Inflow Hydrology with SWAT

Presenter(s): Guobiao Huang (California Department of Water Resources)
Presenter(s) Email Address(es): Guobiao.huang@water.ca.gov
Collaborators: Hongbing Yin, Richard (ZhiQiang) Chen, and Francis Chung (California Department of Water Resources)

Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:
For determining the impact of the non-stationary historical hydro-climate records on the water resources of the California Central Valley, the Soil Water Assessment Tool (SWAT) semi-distributed precipitation-runoff models for Central Valley rim watersheds were further refined spatially, then calibrated and validated with more observed unimpaired streamflow data at interior sub-watershed outlets and basin average snowpack information. To remove the long-term warming trends in historical warming, the linear trends for each of the 12 calendar months from 1921 to 2015 were estimated separately for daily maximum and minimum air temperature in SWAT forcing data. Then air temperature values were detrended by warming each individual temperature series to the pivoting year (2015) level at the end of simulation. Results show that the 94-year warming trend in average temperature is less than 1.0 ◦C, with larger trends in minimum temperature data and smaller or no trends in maximum temperature. The SWAT simulated streamflow differences between original historical climate forcing and detrended warming forcing are then calculated as monthly time series and provided for use in CalSim 3.0 rim historical inflow input adjustment. Overall, historical warming has caused increase in winter runoff and decrease in spring snowmelt runoff in snow-dominated or rain-snow mixed watersheds while little effect seen in rain-dominated watersheds. Other details of the results will be presented.

5. Historical Temperature Detrending Sensitivity Study

Presenter(s): Hongbing Yin (California Department of Water Resources)
Presenter(s) Email Address(es): Hongbing.Yin@water.ca.gov
Collaborators: Richard Chen, Guobiao Huang, Liheng Zhong, Idy Lui, Deepthi Rajsekhar, and Francis Chung (California Department of Water Resources)

Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:
California water resources planning activities including SWP and CVP operations have been based on the observed historical climate and stream flow records. And those historical time series have been implicitly assumed to be stationary or nearly stationary. However, the temperature record in the past 100 years or so showed significant non-stationarity (warming), especially after 1970s'. Does this non-stationarity in historical temperature have any or how much impact on our existing water resources planning and SWP/CVP operations? To answer this question, the Sacramento Valley historical temperature was detrended and rainfall-runoff model SWAT was used to generate detrended rim inflows. Due to the unavoidable significant errors in streamflow timing and/or magnitude even with a good calibration, stream flows simulated by existing rain-runoff models including SWAT may not be directly used in reservoir operations planning studies in which monthly flow sequence plays a very important role. To overcome this weakness, SWAT was run twice, one with the historical temperature and another with the detrended historical temperature. The flow differences between the two runs represent the impact due to the historical temperature warming. The Sacramento Valley water demands were also re-generated with the detrended historical temperature. CalSim 3.0 model was used to simulate the SWP/CVP operations with detrended hydrologic inputs. The study result analysis and recommendations for future studies will be presented.

Session 4. Temperature Modeling

1. The Origins of the Anomalous Warming in the California Coastal Ocean and San Francisco Bay During 2014–2016

Presenter(s): Yi Chao
Presenter(s) Email Address(es): ychao001@gmail.com
Collaborators: Carrie Zhang (UCLA), John Farrara (Remote Sensing Solutions), Joseph Zhang (VIMS), Eli Ateljevich (California DWR), Richard Dugdale and Frances Wilkerson (SFSU)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
During 2014 exceptionally, warm water temperatures developed across a wide area off the California coast and within San Francisco Bay (SFB) and persisted into 2016. Observations and numerical model output are used to document this warming and determine its origins. Coastal warming was mostly confined to the upper 100 m of the ocean and was manifested strongly in the two leading modes of upper ocean (0–100 m) temperature variability in the extratropical eastern Pacific. Observations suggest that the coastal warming in 2014 propagated into nearshore regions from the west while later indicating a warming influence that propagated from south to north into the region associated with the 2015–2016 El Niño event. An analysis of the upper ocean (0–100 m) heat budget in a Regional Ocean Modeling System (ROMS) simulation confirmed this scenario. The results from a set of sensitivity runs with the model in which the lateral boundary conditions varied supported the conclusions drawn from the heat budget analysis. Concerning the warming in the SFB, an examination of the observations and the heat budget in an unstructured-grid numerical model simulation suggested that the warming during the second half of 2014 and early 2016 originated in the adjacent California coastal ocean and propagated through the Golden Gate into the Bay. The finding that the coastal and Bay warming are due to the relatively slow propagation of signals from remote sources raises the possibility that such warming events may be predictable many months or even several seasons in advance.

2. Water Temperature Model Development – Modeling Technical Committee for Shasta Lake and Keswick Reservoir: An Example of a Collaborative Modeling Approach
Presenter(s): Randi Field (US Bureau of Reclamation)
Presenter(s) Email Address(es): rfield@usbr.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Model development, by its very nature, encompasses a wide range of data needs, estimates, and assumptions. Further, model calibration and performance often include experience and the use of professional judgement. Communicating such information in an open forum during model development provides a means to share technical expertise, learn from other disciplines, facilitate communication, efficiently address critical model information (e.g., data sources and limitations, assumptions), adapt to new information, and other benefits. The outcome is a group of resource scientists, managers, and stakeholders that have an appreciation and understanding of modeling aspects. The Modeling Technical Committee (MTC) was developed during the development of both the Shasta Lake and Keswick Reservoir CE-QUAL-W2 models to provide such a forum for agencies and interested parties to participate. Participants include: California Department of Fish and Wildlife, California State Water Resources Control Board, City of Redding, East Bay Municipal Utility District, Essex Partnership, Glenn-Colusa Irrigation District, Hoopa Valley Tribe, National Marine Fisheries Service, National Resources Defense Council, The Nature Conservancy, Santa Clara Valley Water District, Reclamation District 108, Westlands Water District, San Luis Delta Mendota Water Authority, US Bureau of Reclamation, US Fish and Wildlife Service, Western Area Power Agency, and engineering consultants interested in the model development process. Meetings occur approximately once every

six to eight weeks. To date these meetings have addressed model selection, model data needs, model parameter selection, assumptions, calibration, and model performance metrics. This process will continue into 2018 when further model testing and refinement will occur.

3. Shasta Lake and Keswick Reservoir Water Temperature Modeling with CE-QUAL-W2

Presenter(s): Mike Deas
Presenter(s) Email Address(es): mike.deas@watercourseinc.com
Collaborators: Ert Sogutlugil
Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:
The principal objective of this the project is to develop flow and water temperature models for Shasta Lake and Keswick Reservoir to provide additional tools to assist resource managers in developing and implementing annual water temperature management operations. The U.S. Army Corps of Engineers model CE-QUAL-W2 (W2) was selected. The model provides a two-dimensional representation of reservoirs, allowing assessment of longitudinal and vertical gradients, supports branching networks (e.g., dendritic nature of Shasta Lake), is publicly available and open source code (allowing review and modification), and is actively supported. As part of the project bathymetric representations of both Shasta Lake and Keswick Reservoir were created to support W2 modeling. Appropriate hydrology, water temperature, and meteorology data sets were developed for both model application and calibration. The model was implemented for seven years: 2010 to 2016. Unique attributes of these applications include representation of the Shasta Dam Temperature Control Device and associated leakage, and complex hydrodynamics associated with hydropower peaking operations at Shasta Dam and Spring Creek powerhouses. Model output provides an informative and useful means to assess cold water conditions and management actions. Model refinement is continuing in 2018.

4. Folsom Reservoir and Lower American River Water Temperature Modeling

Presenter(s): R. Craig Addley and Vanessa Martinez
Presenter(s) Email Address(es): Craig.Addley@cardno.com, Vanessa.Martinez@cardno.com
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:
Folsom Reservoir, located near Sacramento, California USA, is a deep-storage reservoir that provides municipal water, power generation, and cold water releases for salmonid fish in the lower American River. The dam has discrete temperature control shutters on the three powerhouse intakes that allow the dam operator to choose different water levels at each intake to blend outflow water temperature to accommodate downstream temperature requirements. A complex model of the reservoir was developed using the CE-QUAL-W2 model (Cole and Wells, 2013) with customized code and modeling options and was calibrated to historical operations over a 10-year time period. Absolute mean temperature errors in model profiles and in downstream temperature were 0.57oC and 0.59oC, respectively, well less than the target of <1oC. Variability in meteorological data from different sources and leakage through the temperature control shutters at the dam were challenges during model calibration. A customized operational model tool was developed using the CE-QUAL-W2 model linked to downstream river water temperature modeling to automatically determine how best to select outlet shutter positions to maximize efficient use of the limited cold water available within the reservoir to meet the downstream temperature regulatory targets for fish in the lower American River. The model proved successful in running long-term simulations that can be used to evaluate reservoir operations based on modified or forecasted hydrological and meteorological inputs. The

model has been used for impact analysis, designing the Modified Flow Management Standard for the lower American River, and, periodically, to assist in making operational decisions.

Session 7. Modeling Runoff, Soil Erosion and Mercury Transport at the Watershed Scale with the Wildfire Effect

1. Session Overview

Presenter(s): Nigel Quinn (LBL/USBR)
Presenter(s) Email Address(es): nwquinn@lbl.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
With climate change there an apparent increase in the frequency and intensity of wildfires in California. It is well known that wildfire affects runoff, soil erosion, and mercury transport, however these effects have not previously been modeled quantitatively at the watershed scale. A research project initiated by the Bureau of Reclamation and collaborators in 2017 seeks to develop an integrated model that can predict changes in runoff, soil erosion, and mercury transport in watersheds affected by wildfire. The presentations in this session from leaders in the fields of watershed hydrology and mercury science describe the initial stages of model development, testing, and calibration.

2. Post-Fire Runoff Modeling at the Watershed Scale

Presenter(s): Jun Wang (USBR)
Presenter(s) Email Address(es): junwang@usbr.gov
Collaborators: Vanessa King, Yong G. Lai, Michelle Stern, Lorraine Flint, and Charles N. Alpers
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Previous studies demonstrated wildfires may increase event runoff or erosion by factors of 2–40 over small-plot scales and more than 100-fold over large-plot to hillslope scales. The runoff response from burned watersheds is a function of rainfall (amount and intensity), burn severity, and properties of the impacted soils and vegetation. Burn severity classes (unburned, low, moderate, and high burn severity) reflect the degree of removal of the canopy layer, which intercepts rainfall. Burn severity classes also reflect degrees of soil water repellency effects. High-severity burn can reduce hydraulic conductivity to low values or even zero directly after a fire. Hillslope-runoff-generating processes post-fire may switch between saturation-excess and infiltration-excess overland flow. This presentation will introduce a physically based watershed model that incorporates burn severity classes and the following key components for post-fire runoff simulation: 1) includes both saturation excess and infiltration excess overland flow mechanisms; 2) explicit simulation of vegetation interception pre- and one year post-fire; 3) explicit simulation of post-fire soil water repellency. The model is going to be tested in the Cache Creek Watershed which the Rocky Fire impacted in August 2015.

3. Modeling Soil Erosion and Sediment Transport at the Watershed Scale

Presenter(s): Yong G. Lai (USBR)
Presenter(s) Email Address(es): ylai@usbr.gov
Collaborators: Jun Wang, Vanessa King, Michelle Stern, Lorraine Flint, and Charles N. Alpers

Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:

This talk presents the concept, methodology, and progress of an effort focused on developing a flexible watershed model for runoff and soil-erosion modeling. The aim is to simulate erosion and sediment delivery to rivers and reservoirs. The new model is physically-based, process-oriented, and distributed. A new numerical algorithm to be implemented addresses two issues: (a) terrain representation, and (b) faster model execution. The model grid is raster-based and can be very coarse; finer-scale refinement may be used in areas of local importance. Terrain resolution can be finer than the mesh and is considered in the sediment storage computation. The overland soil-erosion module incorporates the recent developments in sheet and rill erosion research. Two types of erosion model are to be considered and contrasted. One type is the Revised Universal Soil Loss Equation (RUSLE) and its variants; the other type is based on the minimum stream power theory. The effects of wildfire on soil erosion are to be evaluated with this model. The presentation will focus on the methodologies of the model, along with the results of a case study.

4. Modeling the Effects of Wildfire on Mercury and Methylmercury Transport at the Watershed Scale

Presenter(s): C. Alpers (USGS)

Presenter(s) Email Address(es): cnalpers@usgs.gov

Collaborators: J. Wang, Y. Lai, V. King, J. Webster, N. Quinn, J. Weigand, M. Marvin-DiPasquale, J. Fleck

Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:

The effect of wildfire on mercury and methylmercury transport is an issue of importance to resource managers in the western U.S. because of increasing frequency and severity of wildfires in relation to climate change. The western U.S. has many water bodies with mercury concentrations in fish considered to be unsafe for human consumption and a risk to wildlife. Data from the Cache Creek watershed, downstream of Clear Lake, California, are being used for calibration and testing of a watershed model that accounts for the effects of wildfire on runoff, sediment erosion, and mercury transport. There are numerous sources of mercury Cache Creek watershed including historical mercury mines, gold mines where mercury was used for gold recovery by amalgamation, erosion of hydrothermally altered rocks and related soils high in mercury, hot springs, and cold springs. Prior to the Rocky and Jerusalem fires in July-August 2015, the U.S. Geological Survey (USGS) had begun sampling water quality at the gaging station on Cache Creek at Rumsey (USGS station 11451800) in cooperation with the California Department of Water Resources. Eleven water samples were taken between December 2014 and February 2015 (Water Year 2015). After the fires, water-quality monitoring continued during Water Years 2016 (26 samples) and Water Year 2017 (29 samples). The following water-quality parameters were analyzed in each water sample: total mercury (THg) (filtered and particulate), methylmercury (MeHg) (filtered and particulate), reactive (oxidized) mercury (II) (particulate only), suspended sediment (SS) concentration, SS grain-size distribution, major anions (chloride, sulfate, and alkalinity), dissolved organic carbon (DOC), and optical properties (absorption and fluorescence) of dissolved organic matter (DOM). Decreases in the THg content of the SS, seen in Cache Creek and other areas affected by wildfire, are likely caused by volatilization of Hg from fire-affected soil and increased soil erosion from areas with lower natural background THg concentrations. Observed post-fire increases in the MeHg content of SS may be related to increased absorptive capacity of the SS through increased carbon content or increased microbial methylation of mercury (II). The transport model being developed will account for the effect of wildfire on THg and MeHg

contents of SS as a function of burn severity (a combination of burn intensity and duration). Filter-passing concentrations of THg and MeHg will be estimated using observed relationships with DOC concentration and DOM optical properties.

Session 8. Applications of Multi-D Models for Examining Water Quality and Flow – Part 1

1. Water Quality Modeling of Loch Lomond Reservoir with CE-QUAL-W2

Presenter(s): Merve Gorguner, Ph.D. (Watercourse Engineering, Inc.)
Presenter(s) Email Address(es): Merve.Gorguner@watercourseinc.com
Collaborators: Mike Deas, Ph.D., P.E. (Watercourse Engineering, Inc.), Stephen McCord, Ph.D., P.E. (McCord Environmental, Inc.), Taylor Ronne (City of Santa Cruz)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Loch Lomond Reservoir, in the San Lorenzo River watershed, is a mesotrophic reservoir with a capacity of 8,600 acre-ft and an area of 180 acres. The reservoir serves the City of Santa Cruz as a drinking water supply and a public recreational resource. A laterally-averaged, two-dimensional hydrodynamic and water quality model, CE-QUAL-W2, was developed to simulate the reservoir's temperature and water quality under a range of historical conditions and future scenarios. Model calibration was performed for years 2011 through 2016. The step-wise model development process utilized local flow information, water quality data, and meteorological observations. Through calibration and sensitivity analysis key drivers were identified and model input parameters were determined based on mean error estimates. A fully calibrated model was developed to simulate thermocline and oxycline genesis, as well as major nutrients and three algal groups. A hypolimnetic aeration system, multi-level withdrawal structure, and algaecide applications were also successfully incorporated into the model. Model applications will explore alternative withdrawal schemes, a new hypolimnetic oxygenation system, expected conditions under climate change scenarios, and more.

2. Current Status of the SCHISM-CoSiNE Model in San Francisco Bay

Presenter(s): Richard Dugdale (Romberg Tiburon Center, San Francisco State University)
Presenter(s) Email Address(es): rdugdale@sfsu.edu
Collaborators: Fei Chai, Qianqian Liu, Zhengui Wang, Yi Chao
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
An open-source coupled physical-biogeochemical model has been developed for San Francisco Bay (SFB) to study nutrient cycling and plankton dynamics as well as to assist ecosystem based management and risk assessment. The biogeochemical model is based on the Carbon, Silicate and Nitrogen Ecosystem (CoSiNE) model coupled to the unstructured grid, Semi-Implicit Cross-scale Hydroscience Integrated System Model (SCHISM). A multi-year model simulation for SFB (South Bay to Rio Vista) will be described.

The physical and biogeochemical performance was successfully tested using comparisons with shipboard and fixed station observations and show that the SCHISM-CoSiNE model reproduces the spatial and temporal variability in nutrients and phytoplankton biomass. The biogeochemical characteristics of the SFB during wet and dry years are investigated by changing the input of the major rivers. River discharges from the Sacramento and San Joaquin Rivers affect the biomass in northern SFB through both flow and dilution of nutrient (including ammonium) concentrations in the river. The

reduction in residence time caused by increased inflows can result in decreased biomass accumulation, while the corresponding reduction in NH4 favors the growth of biomass, as nitrate is made available for growth. We will 1) present the model findings from publication in final revision and 2) report ongoing efforts to refine predictions of phytoplankton blooms in the northern SFB.

3. Evaluation of Sediment Supplementation to the Lower Sacramento River to Increase Turbidity in the Low Salinity Zone

Presenter: Aaron Bever (Anchor QEA)
Presenter Email Address: abever@anchorqea.com
Collaborators: Michael MacWilliams (Anchor QEA)
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
The Delta Smelt Resiliency Strategy outlines proposed management actions intended to improve the status of Delta Smelt. This study used the UnTRIM Bay-Delta 3-D hydrodynamic, wave, and sediment transport model to better understand the effectiveness of sediment supplementation in the Low Salinity Zone, which is one of the management actions proposed in the Delta Smelt Resiliency Strategy. The model includes the primary physical processes necessary to simulate the continual erosion, deposition, and transport of sediment throughout the Bay-Delta, and converts suspended sediment concentration (mg/L) to turbidity (NTU) using conversion curves developed from field observations. Sediment was supplied to the lower Sacramento River near Decker Island at a rate that resulted in a predicted increase in turbidity of 10 NTU between Emmaton and Mallard Island. The sediment supply predicted to be necessary to increase the depth-averaged turbidity by 10 NTU was estimated to be 3552 yd3/day, or 543,000 yd3 over a 5-month sediment supplementation period based on the sediment parameters used. However, due to uncertainty regarding the grain size composition and sediment properties of the dredged material that would be used for supplementation, and the effectiveness of the slurry at resuspending sediment, this should be considered an order-of-magnitude estimate. Sediment supplementation at Decker Island was effective at increasing turbidity downstream into the confluence region and eastern Suisun Bay, with relatively smaller effects upstream in the Sacramento and San Joaquin Rivers. Sediment supplementation was predicted to be more effective during periods of relatively lower Delta outflow.

4. SCHISM Bay-Delta Modeling Study for Franks Tract Restoration Feasibility Study

Presenter: Kijin Nam (DWR)
Presenter Email Address: Kijin.Nam@water.ca.gov
Collaborators: Eli Ateljevich (DWR)
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
One of actions proposed in Delta Smelt Resiliency Strategy to improve the status of Delta Smelt is Franks Tract Restoration Feasibility Study. The conceptual plan of the Restoration project includes marsh restoration and a large barrier in the western Franks Tract. California Department of Water Resources performed three-dimensional hydrodynamics modeling using the Bay-Delta SCHISM model in support of the feasibility study for California Department of Fish and Wildlife (CDFW) to examine the feasibility and impact of the partially restored Franks Tract.

The modeling study reviewed estimated changes of flow velocity and stage in the restored area during and after construction to find a good alternative and to provide information for an engineering feasibility assessment under the year 2009 historical condition. Estimated change in stage, flow, and

salinity in the Sacramento-San Joaquin Delta by the project are also reviewed. Overall effect of the proposed restoration design is similar to that of the 2015 Emergency Drought Barrier (EDB) at the False River, but the effect is attenuated in the restoration scenarios. The modeling study investigated the effect of submerged aquatic vegetation (SAV) in the unrestored eastern part of Franks Tract, the combined effect of other proposed restoration projects is the Delta, and locally proposed alternatives. A set of three-dimensional particle tracking are performed to investigate estimated impact in particle entrainment.

Session 10. Integrated Water Resources Modeling

1. Statewide Evaluation of "No Overdraft Policy" with a Hydroeconomic Model, CALVIN

Presenter(s): Mustafa Dogan
Presenter(s) Email Address(es): msdogan@ucdavis.edu
Collaborators: Ian Buck, Jay Lund
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
California recently passed legislation (SGMA) that requires the elimination of groundwater overdraft in the coming decades. Although California's overdraft occurs primarily in the southern Central Valley, ending overdraft will affect California's extensive water supply system and operations. Here we used CALVIN, a statewide hydro-economic water allocation and operations model of California's interconnected water system to assess statewide effects of ending long-term groundwater overdraft in the Central Valley for several water management cases with a historical and a warmer and drier climate. CALVIN optimizes agricultural, urban and environmental deliveries using 82 years of historical inflow hydrology. Results for projected 2050 demands and historical hydrology are compared to results with a perturbed hydrology representing a warmer and drier climate with 28\% less streamflow. Several policies are applied to Sacramento-San Joaquin Delta (Delta) exports, water transfers, and the Delta outflow to San Francisco Bay. Some of these policies are beyond the scope of SGMA, but we evaluated to find optimum adaptations. The `no overdraft' policy reduces groundwater availability and a warmer and drier climate reduces surface water availability, increasing water scarcities. The economic, environmental and policy consequences of such adaptations, and of not adapting, are large, with statewide effects.

2. Estimating Subregional Outflow Adjustments using ANN to Improve C2VSIM Simulations

Presenter(s): Tariq Kadir
Presenter(s) Email Address(es): Tariq.Kadir@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The concept of a "closure" term by DWR to develop hydrologies for planning studies in CalSim has been extended to the Integrated Water Flow Model IWFM and showcased by its application to C2VIM. For a C2VSIM historical run, computed subregional outflow (stream outflow) will differ from observed/estimated outflow. That difference (adjustment) built back into the C2VSIM will result in "perfect match" to simulated outflows, by construction. By quantifying those values and modeling them in terms of hydrological parameters computed within C2VIM, allows for dynamically estimating them in a C2VSIM run, and to apply them to a "projected level run". This presentation will present results of: 1. quantifying the historical adjustments for C2VSIM, 2. Modeling the adjustments using Artificial Neural Networks (ANN's) as a function of 14 parameters, 3. Building the sub-regional ANN's

back into C2VSIM, 4. Presents results of the impacts on Delta inflow for both the historical run and a projected level run.

3. Sacramento Valley Simulation Model - SVSim: Advances in the Simulation of Stream Depletion Caused by Groundwater Pumping in the Sacramento Valley

Presenter(s): Linda D. Bond
Presenter(s) Email Address(es): Linda.Bond@water.ca.gov
Collaborators: Woodard Curran, Timothy J. Durbin, Inc., S.S. Papadopulos & Assoc., Inc.
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Based on the physical principles that control the process of stream depletion caused by groundwater pumping, the Sacramento Valley Simulation Model (SVSim) was designed to specifically assess stream depletion caused by groundwater substitution transfer projects in the Sacramento Valley.
SVSim builds upon DWR's integrated groundwater-surface water model of the Central Valley (C2VSim). To improve the ability to calculate the effects of transfer projects, groundwater substitution pumping was explicitly simulated in SVSim, the model's discretization was tested and redesigned, and the representation of basin hydrogeology was reformulated. The representation of the transmission and storage properties of alluvial basins, such as the Sacramento Valley, in numerical models is particularly challenging. The depositional structure and groundwater flow paths of alluvial basins do not correspond to the typical conceptual model of a layer-cake hydrogeologic system with alternating aquifers and aquitards (Fogg, et al., 2000). These are important differences because the structure of the groundwater systems significantly effects the timing, location, and magnitude of pumping impacts on regional surface-water flows (Barlow and Leake, 2012). To address this challenge, SVSim uses an extensive database of high-quality lithologic logs and aquifer test results and employs the power law equation, which translates the primary characteristics of the alluvial basin into hydrogeologic parameters for the model (Faunt et al., 2010; Durbin et al., 2017). This presentation will provide an overview of the groundwater substitution transfer pumping, model discretization testing, and the development of hydrogeologic parameters.

4. Central Coast Hydrologic Region Pilot: Water Budget & Multi-Cropping

Presenter(s): Paul Shipman (California Dept. of Water Resources), Frank Qian (Woodard & Curran) and Julie Hass (California Dept. of Water Resources)
Presenter(s) Email Address(es): Paul.Shipman@water.ca.gov; fqian@woodardcurran.com
Collaborators: Salma Kibrya (California Dept. of Water Resources), Steve Ewert (California Dept. of Water Resources), and Morteza Orang (California Dept. of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The California Department of Water Resources (DWR) completed Water Budget Pilot Project for the Central Coast Hydrologic Region. The purpose of this pilot project was to develop water budget for an area without easily accessible and complete data available to DWR. The presentation covers progress to date, lessons learned from the pilot, and water budget dashboard implemented to synthesize and share water budget information resulting from the pilot project.

As part of the pilot project, DWR developed new approach to deal with multi-cropping in the Central Coast Hydrologic Region utilizing the California Pesticide Information Portal database, DWR county land use surveys, Agricultural Commissioners reports, information provided by local farm advisors, DWR's land surface model Cal-SIMETAW, and reported pumping numbers from the Monterey County

Water Resources Agency. The approach developed provides a transparent way to quantify agricultural water demands for areas previously difficult to evaluate due to intense multi-cropping.

Session 11. Machine Learning

1. Precipitation Estimation from Satellites using Machine Learning Methods
Presenter(s): Kuolin Hsu (UC Irvine)
Presenter(s) Email Address(es): kuolinh@uci.edu
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Understanding spatial and temporal distribution of precipitation is important for hydrologic process modeling and water resources systems management. Effective integration of measurements from multiple sources (e.g. gauge, radar, and satellites) are critical for providing reliable precipitation estimation. Recent development in computational Intelligence has shown good progress in using a large amount of in situ and remote sensing data to improve the quality of precipitation measurement. In this study, Artificial Neural Networks (ANNs) were used to integrate multi-sensors from satellites for precipitation estimation. The proposed ANNs were trained using multi-spectral images from satellites and ground measurements (gauges & radar). Case studies will be presented through monitoring of extreme storm events. In addition, application of the proposed methods for the near-time precipitation monitoring as well as for the reconstruction of historical precipitation data will be discussed.

2. Prediction of the Surface Runoff Quality Using Machine Learning and Deep Learning Methods
Presenter(s): Jing Liang (UC Riverside)
Presenter(s) Email Address(es): jlian014@ucr.edu
Collaborators: Wenzhe Li (USC), Scott A. Bradford (USDA), Jiří Šimůnek (UC Riverside)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Contaminants can be rapidly transported at the soil surface by runoff to surface water bodies. Physically-based models, which are based on the mathematical description of main hydrological processes, are key tools for predicting surface water impairment. Along with physically-based models, data-driven models are becoming increasingly popular for describing the behavior of hydrological and water resources systems since these models can be used to complement or even replace physically based-models when there is the lack of required data. Here we propose a new data-driven model as an alternative to a physically-based overland flow and transport model. First, we have developed a physically-based numerical model to simulate the overland flow and contaminant transport (the HYDRUS-1D overland flow module). Then, a large number of numerical simulations were carried out to develop a database containing information about the impact of various relevant factors on surface runoff quantity and quality. Numerical simulations were conducted to evaluate the influence of different weather patterns, surface topography, vegetation, soil conditions, contaminants, and best management practices on runoff water quality. Finally, the resulting database involving various input/output surface runoff interactions was used to train data-driven models. Machine Learning and Deep Learning techniques were explored to prepare input - output functional relations. The results indicated that the Deep Feed-Forward Network Models perform the best among selected data-driven models.

3. A Hybrid Boosted Regression Tree Model to Predict and Visualize Nitrate Concentration Throughout the Central Valley Aquifer

Presenter(s): Katherine Ransom (UC Davis)
Presenter(s) Email Address(es): kmlockhart@ucdavis.edu
Collaborators: Thomas Harder (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

We developed a hybrid machine learning model with the boosted regression tree (BRT) method to assess the risk of nitrate contamination of groundwater in the Central Valley aquifer at depths up to approximately 500 m below ground surface. The hybrid approach included as predictor variables, outputs from existing physically based models of the Central Valley. A database of 145 predictor variables representing well characteristics, historical and current field and landscape-scale nitrogen mass balances, historical and current land use, oxidation/reduction conditions, groundwater flow, climate, soil characteristics, depth to groundwater, and groundwater age were assigned to over 6,000 private supply and public supply wells measured previously for nitrate and located throughout the study area. The BRT method was used to rank variables on their importance to nitrate concentration in the study wells.

Twenty-five variables were selected for the final model for log-transformed nitrate, which was used to predict nitrate concentration in the aquifer at 17 depth zones. The most important predictor variables included two oxidation/reduction variables and two nitrogen input variables. In general, increasing probability of anoxic conditions had a corresponding decrease in nitrate concentration predictions. Conversely, increasing nitrogen inputs had an increasing relative impact on nitrate predictions. Three-dimensional visualization indicates that nitrate predictions generally decreased with increasing groundwater age.

4. A Hybrid Empirical-Bayesian Artificial Neural Network Model of Delta Salinity

Presenter(s): John Rath (Tetra Tech)
Presenter(s) Email Address(es): john.rath@tetratech.com
Collaborators: Paul Hutton, Limin Chen, and Sujoy Roy (Tetra Tech)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

Salinity in the San Francisco Bay-Delta is subject to environmental controls for the protection of endangered aquatic species and municipal water supplies. The consequences of Delta salinity management affect freshwater withdrawals that support the needs of more than 20 million people and 3 million acres of irrigated land throughout California. We developed a hybrid artificial neural network (ANN) model that incorporates and improves upon an empirical model of Delta salinity. The hybrid model was trained using nine decades of salinity, flow, and sea level data.

The hybrid model results in increased quality of fit and uncertainty estimation compared to the simple empirical model while still maintaining plausible sensitivity to all physical parameters compared to fully unconstrained ANNs. The fitted model is able to produce predictions that are more accurate than simpler empirical models without the extreme runtime or data requirements of fully resolved physical models. The hybrid ANN model has been used in a case study of the evolution of Delta salinity behavior over the past century.

Session 12. Grab Bag Session #1: Data, Models, and Tools to Inform Insights and Analysis

1. Visualization and Calibration of IWFM Applications in 3D using GroundWater Desktop

Presenter(s): Marinko Karanovic (S.S. Papadopulos & Associates, Inc. (SSP&A))
Presenter(s) Email Address(es): karanovicm@sspa.com
Collaborators: Matthew J. Tonkin (SSP&A)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
GroundWater Desktop (GWD) is a fully three-dimensional (3D) data visualization and simulation model post-processing tool developed to support both structured and unstructured model grid formats, including finite elements. Although originally developed to support MODFLOW-platform models – including the unstructured MODFLOW-USG format – GWD was in recent years extended to support models developed using the California Department of Water Resources (CDWR) Integrated Water Flow Model (IWFM) code. As such, GWD is now capable of importing models constructed using the IWFM code, and visualizing the simulation aquifer and stream-related parameters, boundary conditions, and simulation results, together with groundwater pumping and observation well locations and time-series data and other 3D data within an intuitive user environment. In doing so, GWD can greatly facilitate the calibration of models developed using the IWFM code by plotting measured and simulated time-series (hydrographs) for groundwater heads and for streamflows. The 3D visualization capability empowers model application developers and reviewers the capability to rotate, slice and dice models, data, and results dynamically. GWD is under continual development to add features and capabilities that support IWFM model applications.

2. Forecasting ET Demand: Klamath Secure Reservoir Ops Pilot Project

Presenter(s): Zackary Leady (USBR)
Presenter(s) Email Address(es): zleady@usbr.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Python ET-Demands Model was originally developed by the U.S. Bureau of Reclamation (USBR) and the Desert Research Institute (DRI) for calculating the actual crop evapotranspiration based on the implementation of the methods described in FAO-56. As part of the Klamath Secure Reservoir Operations Pilot Project, the Python ET-Demands Model was modified with a forecasting module. The forecasting module is capable of ingesting forecasted input weather variables and calculating the forecasted crop evapotranspiration at a user specified forecasting interval for a specific study area. The forecasting module is also an integral part of a larger reference ET network hosted on the HydroInspector platform. The HydroInspector platform provides web visualization of study areas, weather station locations, input data, and graphical results developed. The final result illustrates a comparative analysis of modelled forecasted inputs and outputs vs. the historically recorded weather station data demonstrating good agreement using the forecasting module.

3. Hydraulic Model Analysis near the Confluence of Lower Feather River and Sutter Bypass

Presenter(s): Sungho Lee (Central Valley Flood Protection Board)
Presenter(s) Email Address(es): Sungho.Lee@CVFlood.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:
The hydraulic analysis for high flood condition (100-yr flood) near the confluence of Lower Feather River and Sutter Bypass have been studied to compare the result of 1-dimensional (1-D) HEC-RAS model (SacBasin) and 2-dimensional (2-D) RMA2 hydraulic model.

The bed elevation of outer bend (right, west) side is maximum 7.3 ft higher than that of inner bend (left, east) side at the upstream of Gilsizer Slough (GS) and it is maximum 11.4 ft lower than that of inner bend (left, east) side at the downstream outer bend of GS. The water surface elevation (WSEL) at the outer bend (right, west) side near the bend of the GS is 0.1- 0.3 ft higher than that of inner bend (left, east) side. The maximum velocity appears at upstream (before) inner bend of left (east) side. The bed elevation of north bank at upstream of the bend of Feather River is 15 ft higher than that of south bank. The channel bottom centerline drops suddenly from 18.0 ft to -8.0 ft (26 ft drops) at the bend. The WSEL of outer bend (right, north bank) near the bend is maximum 1.0 ft higher than that of inner bend (left, south bank). The velocity of the channel centerline of the Feather River ranges from 7.0 ft/s to 10.0 ft/s near the bend. There is a high possibility of erosion at the bend of Feather River. The bed elevation of outer bend (left, east) side is higher than that of inner bend (right, west) at the confluence of Sutter Bypass and Feather River. The WSEL of outer bend (left, east) side is also higher than that of inner bend (right, west) at the upstream and downstream of the confluence. The WSEL is decreased at the confluence of Sutter Bypass near Nelson Bend Control Structure. The maximum decrease of WSEL is 3 ft at the confluence. The velocity of Sutter Bypass ranges from 3 ft/s to 5.6 ft/s. The velocity of inner bend (right, west) side is higher than that of outer bend (left, east) side and confluence area except central part of floodway.

The hydraulic result of 1-D model is not proper to handle the super-elevation issue. 2-D model should be applied to get more detailed hydraulic analysis near the confluence of Sutter Bypass and Feather River.

4. Multivariate Drought Risk Atlas for Sacramento Valley for Future Climate Scenarios

Presenter(s): Deepthi Rajsekhar (California Department of Water Resources)
Presenter(s) Email Address(es): Deepthi.Rajsekhar@water.ca.gov
Collaborators: Hongbing Yin, Richard Chen, Jay Wang, Liheng Zhong, and Idy Lui (California Department of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Droughts are considered to be the costliest of all natural disasters with widespread socio-economic impacts. Unlike other natural hazards, droughts are considered to be a “creeping disaster” – slow to develop and slow to recover, sometimes lasting for many years. Drought events are defined by multiple attributes like severity, duration, and frequency, and an interplay between these attributes will define the risk posed by the event. There is growing evidence that climate change may lead to unprecedented increase in future drought risk. In this study, we provide a set of multivariate hydrologic drought risk map for Sacramento Valley considering the implications of climate change. A copula based statistical approach is utilized to effectively assess drought risk considering multiple attributes like drought severity, duration, and frequency. The maps are provided for: (a) base scenario - the drought risk is calculated considering the current climate condition, (b) RCP4.5 scenario - the projected drought risk is calculated for a future with peak emissions around mid-century and rapid decline thereafter, and (c) RCP8.5 scenario - the projected drought risk is calculated for a future in which the emissions continue to increase rapidly. These maps will serve as a simple tool that enables

decision makers to analyze the projected drought risk for Sacramento Valley, and compare it with current risk levels to develop future adaptation strategies.

Session 13. Grab Bag Session #2: River Flows, Controls, Water Quality and Management

1. Effects of Stormwater Capture and Use on Urban Streamflows

Presenter(s): Erik Porse (CSU Sacramento)
Presenter(s) Email Address(es): erik.porse@owp.csus.edu
Collaborators: Stephanie Pincetl, Mark Gold, Terri Hogue, Diane Pataki, Kathryn B. Mika, Elizaveta Litvak, Kimberly Manago
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Many cities in California use stormwater to enhance local water supplies. Capturing and using stormwater in urban watersheds can have benefits beyond groundwater recharge, including reduced pollutant loading in downstream watersheds. But in California's seasonal climate, capturing stormwater could affect urban streams. Using a model of regional urban water resources management in Los Angeles (Artes), analysis indicates that for the watersheds of L.A., further increasing stormwater capture and use could significantly reduce urban streamflows, especially in downstream basins. Results illustrate potential tradeoffs in water supply, in-stream water flows, and aquatic habitat that must be considered when looking to better utilize local water resources.

2. Delta Outflow & Salinity: Trends and Change Attribution

Presenter(s): Paul Hutton (Tetra Tech)
Presenter(s) Email Address(es): paul.hutton@tetratech.com
Collaborators: Sujoy Roy (Tetra Tech)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Freshwater flow through the Delta is essential for repelling salinity intrusion and is critical to the ecosystem health of the estuary. Management of flow and salinity in the Delta has been a long-standing concern and today is regulated to support both human uses and aquatic life. As part of efforts to restore the Delta ecosystem to a more natural state, there is great interest in understanding changes that have occurred in the freshwater flows and estuarine salinity as a consequence of changes in the watershed following European settlement in the mid-18th century. To partly address this need, several studies were conducted and published by the author, in collaboration with several colleagues, to evaluate the nature of changes in Delta flow and salinity as well as the underlying drivers of those changes.

This presentation draws from several of these studies, highlighting key methods, results and conclusions from those studies that focus on change over the last nine decades during which systematic measurements of flow and salinity are available. By focusing on the last nine decades, it is recognized that the baseline is not representative of pristine or natural conditions, and that numerous landscape changes had already occurred. However, the watershed continued to undergo significant hydrologic alteration over this period, the most important being the construction of all major reservoirs in existence today and export facilities as well as the further conversion of undisturbed lands to irrigated agriculture.

3. Drought Stress Tests for Water Supply: Residential Well Impacts and Economic Externalities
Presenter(s): Robert Galey (UC Davis)
Presenter(s) Email Address(es): rmgailey@ucdavis.edu
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
Many residential wells went dry during the drought from 2012 through 2016. This is especially true for the southern Central Valley where there is a concentration of disadvantaged communities that also experience poor water quality (nitrate, arsenic, etc.). An analysis of impacts to residential wells during the drought is performed for Tulare County where a detailed dataset on residential wells going dry during the drought is available. The inventory of residential wells located on the valley floor is categorized by location and screened interval depth at the resolution of one square mile. This information is then compared to declines in groundwater levels, potential actions to maintain supply continuity (pump lowering, screen rehabilitation and well replacement) are considered and costs for those actions are estimated. The impact and cost estimation model is calibrated against information on wells that actually went dry and uncertainty in the cost estimates are evaluated. Potential for using the model to perform analysis required for groundwater sustainability plans under the Sustainable Groundwater Management Act is demonstrated. Finally, applying the modeling approach to other areas in the Central Valley is discussed.

4. How to Live with No Regrets: Informing Policy Decisions through Marginal Economic Analysis of Water Supply and Demand Management Actions Under Uncertainty

Presenter(s): Alvar Escriva-Bou (PPIC)
Presenter(s) Email Address(es): escriva@ppic.org
Collaborators: Josue Medellin-Azuara, Ellen Hanak, Jay Lund
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Almost half of California's San Joaquin Valley water supplies are imported from other regions or extracted unsustainably from the aquifer. Whereas environmental concerns are likely to affect imports, the Sustainable Groundwater Management Act of 2014 requires to bring groundwater basins into balance by 2040. Given that agriculture is a leading economic driver in the Valley, many projects looking for supply augmentation and demand management are under scrutiny to avoid major economic disruptions.

To inform policy decisions, we study all major supply and demand management proposals using a marginal economic analysis. Every proposal is evaluated assessing the potential "new water" or "savings" that would provide on an annual basis, and the equivalent annual costs. To account for uncertainty, we include the likely ranges of water provided/saved and the costs of the projects. For any uncertain future realization, and using a Monte Carlo approach, we obtain the optimal set of actions by obtaining a supply and demand curve representing marginal costs and benefits for each supply and demand management action. Using this methodology, those actions that are selected in most of the realizations are considered "no-regret policy decisions", and actions are ordered to inform decision makers on the best economic pathways.

Session 16. Application of Multi-D Models for Examining Water Quality and Flow – Part 2

1. Hydraulic Modeling to Estimate Proportional Water Sources to the Lower Sacramento River

Presenter(s): Lisa Thompson (Sacramento Regional County Sanitation District)
Presenter(s) Email Address(es): thompsonlis@sacsewer.com
Collaborators: Tim Mussen (Regional San), Justin Nordin (Regional San), Marianne Guerin (Resource Management Associates (RMA)), Richard Rachiele (RMA), Donald J. Smith (RMA)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Modeling expertise informed a longitudinal Sacramento River survey conducted in May and October 2016. Model outputs will be used in the interpretation of survey data, including water quality, phytoplankton, zooplankton, and clam biomass. RMA developed and calibrated the RMA2 and RMA11 models for flow and water quality transport from the upper Sacramento and Feather Rivers through the Delta to a downstream boundary at Martinez. Model output estimated volumetric percentages of source waters at ten sampling locations between approximately Knights Landing and Isleton. The main sources were the Feather, Sacramento and American Rivers. Secondary sources, such as the Colusa Basin Drain and East Canal, were included when data were available. To support the modeling effort, the field crew collected cross-river transects and vertical water profiles for temperature and electrical conductivity (EC) at tributary confluences. These data were used in model calibrations for mixing at confluences and volumetric calculations at well-mixed locations. Notably, calibration of the model was facilitated by the EC measurements. When combined with flow data, the mixing of waters at and below most confluence locations could be replicated, and the volumetric calculations at most well-mixed locations replicated measurements provided by the flow and EC data. This project highlights the value of coordinating the activities of field crews and modelers, so crews can collect model calibration data over the same temporal and spatial framework as other field data. Modelers can then provide more reliable calibration and validation of models in support of specific field studies, and improve future model performance.

2. Improving System Wide Flood Intelligence on the Sacramento River System Using Forecast NWS Data

Presenter(s): MD Haque (CA DWR)
Presenter(s) Email Address(es): Md.Haque@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract: The California Department of Water Resources (DWR) is developing a real-time dynamic hydraulic modeling and mapping system to provide forecast flood intelligence on the Sacramento river system and its floodplains. This presentation discusses the modeling aspects, challenges and potential improvements using the USACE hydrologic engineering center (HEC) HEC-RAS 5.0 modeling software coupled with the NWS California-Nevada River Forecast Center's ten-day hydrologic forecast product. The goal is to provide better communication and flood intelligence for the emergency managers and decision makers regarding the potential impacts of high river stages in the floodplain areas if there is a failure. The model development approach, run control parametric sensitivities in particular to achieve a balance between model runtime and model accuracy for producing reasonable results in real-time will be discussed.

3. Transport Between Ponds, Sloughs, and the Open Bay: Hydrodynamics in Lower South Bay
Presenter(s): Rusty Holleman (SFEI)
Presenter(s) Email Address(es): rustyh@sfei.org
Collaborators: David Senn (SFEI), Edward Gross (RMA)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Lower South San Francisco Bay is home to the largest tidal wetland restoration project on the US West Coast. It is also home to the highest ambient nutrient concentrations in San Francisco Bay.

Ponds, former ponds, sloughs, mudflats and subtidal channels all play a part in the transport and processing of nutrients and biomass. As restoration progresses, populations grow, and ambient conditions change, it is important to understand fundamental transport and mixing processes in this portion of the Bay. Numerical models are an essential tool in quantifying how best to manage flows into and out of ponds, and the capacity of the system to handle present and future nutrient inputs. Hydrodynamic models are also valuable in elucidating the role of freshwater from local stormwater and wastewater flows, and how flushing of South Bay may change under altered flow states.

In order to support these applications and related management questions, we have developed a 3D hydrodynamic model with an emphasis on the ponds and sloughs of Lower South Bay. This model is an extension of a Bay-wide hydrodynamic model adapted from the USGS CASCaDE project.
The model accurately captures many aspects of salinity dynamics in the complex configurations of ponds and sloughs, including the roles of several wastewater outfalls in the vicinity. In addition to the technical aspects of the model, we have explored a community modeling approach in the development of this model, and will share details of this experience.

4. Modeling Water Age in the Upper San Francisco Estuary
Presenter(s): Edward Gross
Presenter(s) Email Address(es): ed@rmanet.com
Collaborators: Stephen Andrews, Scott Burdick, Thomas Handley, Bryan Downing, Brian Bergamaschi
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
Transport time scales are commonly used in hydrodynamic and ecological studies to provide insight to the rate of transport processes relative to ecological processes, such nutrient uptake rates. Transport time scales can be estimated both from field observations and from hydrodynamic modeling. Recently continuous underway measurements have been used to detect isotopic signals of evaporation. These can be used to estimate a transport time scale which is conceptually analogous to water age as defined in modeling studies. We apply two modeling approaches to estimate water age. Both approaches utilize predicted hydrodynamics from a version of the RMA San Francisco Estuary UnTRIM model which incorporates a high-resolution grid of the Cache Slough Complex developed at UCD. The first approach utilizes conservative tracers while the second approach uses particle tracking. We compare predictions with observational measures of transport times in the Cache Slough Complex estimated from a survey during October of 2014. We evaluate sources of uncertainty in each approach and suggest possible improvements. The results are a major step in establishing confidence in modeling approaches to estimate ecologically relevant transport time scales. Validated modeling approaches allow much larger spatial and temporal extents of estimated transport time scales relative to current observational approaches. Furthermore, truly synoptic maps and tidally-averaged maps of

water age can be readily generated from model results and model results can be used in conjunction with observational data to provide insight to biological and chemical rates in the estuary.

Session 17. California Water Plan Update 2018: Envisioning and Tracking California Water Sustainability

1. California Water Plan 2018 – Outcome-Based Planning for Better Policy Decisions

Presenter(s): Paul Massera (California Dept. of Water Resources)
Presenter(s) Email Address(es): Paul.Massera@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The people and ecosystems of California are living a tale of two extremes — drought and flood. Several additional challenges are threatening our state's water future such as groundwater overdraft, increasing water demands and flood risk, declining ecosystems, aging infrastructure, declining watershed health, including historic levels of tree mortality and resulting catastrophic wildfires. The California Water Plan Update 2018 (Update 2018) provides recommendations to overcome these challenges and charts a path toward a more sustainable water future. It provides specific, implementable guidance to address the foundational causes of these challenges, which directly correlate to the five priorities of Update 2018:

A. Improve Alignment of Agencies' Initiatives and Governance.
B. Improve Regulatory Framework to Reconcile Environmental Needs and Human Activities.
C. Provide Resources, Knowledge, Skills, and Tools Water Managers Need for Data-Driven Decision-Making.
D. Provide Sufficient and Stable Funding.
E. Modernize and Rehabilitate Water Resource Management Systems.

In addition to the recommendations, Update 2018 provides an operational description of statewide sustainability; a method to evaluate the sustainability of the state's water resources and to prioritize policy and investment; schedule, responsibilities, and options for funding Update 2018 implementation; and an annual progress reporting process that also offers timely policy and investment decision-support.

Whether the state effectively adapts to its many challenges will depend on the choices all Californians make. The recommended actions, funding options, and implementation plan presented in Update 2018 provides actionable guidance for these choices.

2. Water Budget Development Practitioner's Handbook

Presenter(s): Todd Hillaire (California Dept. of Water Resources), Abdul Khan (California Dept. of Water Resources), and Saquib Najmus (Woodard & Curran)
Presenter(s) Email Address(es): Todd.Hillaire@water.ca.gov; Abdul.Khan@water.ca.gov; snajmus@woodardcurran.com
Collaborators: Julie Haas (California Dept. of Water Resources), Frank Qian (Woodard & Curran), and Brian Van Lienden (Woodard & Curran)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

Water Budget Development Practitioner's Handbook will provide the water resources community of California with a tool to develop total water budgets, for a specific geographic area and for a specific time period, using data and models, or a combination thereof. The handbook will support the development and implementation of groundwater sustainability plans (GSP), pursuant to the sustainable groundwater management act (SGMA) of California. The SGMA requires that all groundwater sustainability agencies (GSA) develop and report total water budget, which is an accounting of the water entering in and leaving from all parts of the managed water system: the land surface system, the surface water system, and the groundwater system. The handbook will include 1) identifying key components of the hydrologic cycle for developing a total water budget of a basin, 2) describing each component along with practical methods for estimating it with or without numerical models, 3) providing examples of methods using only data or post-processing model outputs, and 4) describing the most commonly used sources for data and information related to water budget. This presentation will provide an overview and the status of the handbook's development.

3. California Water Plan Update 2018 Water Balance Data and Tools

Presenter(s): Jennifer Kofoid (California Dept. of Water Resources)
Presenter(s) Email Address(es): Jennifer.Kofoid@water.ca.gov
Collaborators: Tito Cervantes (California Dept. of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

The California Department of Water Resources (DWR) prepares and publishes water balances for the ten hydrologic regions of California as well as the state as whole. Water balances are an essential component of the California Water Plan and related supporting documents. California Water Plan Update 2018 (Update 2018) water balances for developed and dedicated water supply and use provide a detailed accounting of urban and agricultural water uses, water required for and dedicated to the environment, and water supplies that met those needs. Update 2018 adds analyses based on inflow-outflow water balance methodology for water years 2011 through 2015 to analyses for water years 1998 through 2010 developed during the two previous water plan updates. This presentation will highlight water years 2011 through 2015 water balance data and tools that have been developed as part of Update 2018. The Water Supply and Balance team charged with developing the water balances consists of members from DWR's Headquarters and each of the Region Offices, as well as collaborators including UC San Diego, Western States Water Council, and U.S. Geological Survey.

4. Development of the California Regional Water Management Atlas

Presenter(s): Lew Moeller (California Dept. of Water Resources)
Presenter(s) Email Address(es): Lewis.Moeller@water.ca.gov
Collaborators: Todd Thompson (California Dept. of Water Resources) and Mike Floyd (California Dept. of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

The transition of the California Water Plan from preparing elaborate regional reports to a more compact regional water management atlas to depict regional water picture in California is presented and discussed.

Water Code Section 10013 directs DWR to include, in the California Water Plan, a report on the development of regional and local water projects within each hydrologic region of the state. This requirement has been met in the past through the development of regional reports.

In March 2017, DWR published "Stakeholder Perspectives – Recommendations for Sustaining and Strengthening Integrated Regional Water Management." One of the 71 principal actions in the stakeholder perspectives document is "Publish and maintain a web-based IRWM atlas summarizing the makeup of IRWM regions across the state, and their water management challenges and successes."

DWR is currently developing the California Regional Water Management Atlas (Atlas) to help fulfill the statutory requirement for regional reports, and to address the need for a regional water management atlas, as recommended in the stakeholder perspectives document. The Atlas will also serve as a foundational element for the development of Water Plan Update 2023.

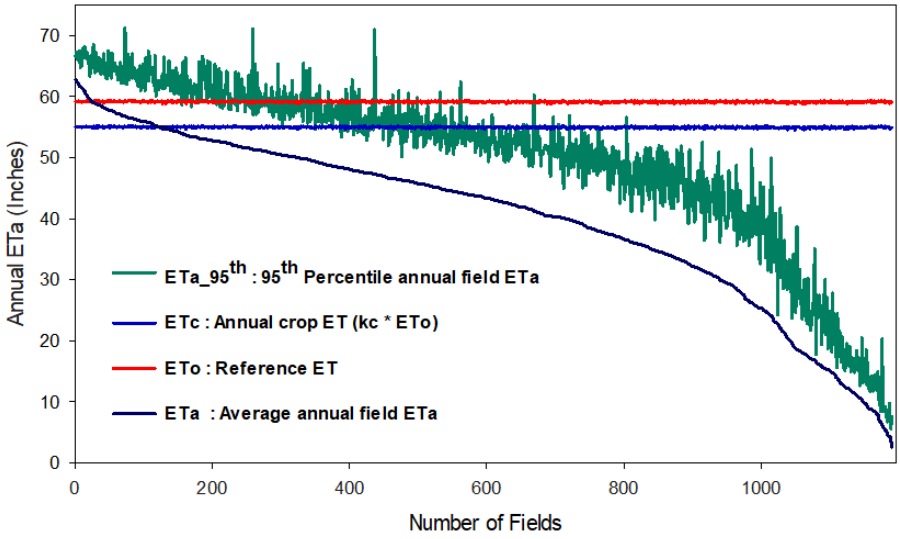
5. AB 1755 The Open and Transparent Water Data Act: Putting Data to Work
Presenter(s): Chris McCready (California Dept. of Water Resources) and Matt Correa (California Dept. of Water Resources)
Presenter(s) Email Address(es): Christina.McCready@water.ca.gov; Matthew.Correa@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The California Department of Water Resources (DWR) staff will review requirements of the Open and Transparent Water Data Act (Assembly Bill 1755, Dodd) and provide updates on State-led implementation efforts, including a strategic plan, a draft implementation plan, and preliminary protocols and standards.

Session 18. ET & Remote Sensing

1. Applications of CalETa in Water Resources Management
Presenter(s): George Paul (Formation Environmental, LLC)
Presenter(s) Email Address(es): gpaul@formationenv.com
Collaborators: Pete Townsend, Brian Schmid, Chuan-Shin Chong, Mark Roberson, Tom Hawkins, Aaron Smith, Dane Williams, Clint Keller (Formation Environmental, LLC)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
CalETa is a daily, 30-meter, statewide evapotranspiration dataset for California developed using an innovative and cost-effective framework utilizing publicly available satellite imagery and a surface energy balance algorithm. CalETa is used in various studies across the state. Agricultural applications of CalETa include monitoring field-scale variability using ETa-distribution uniformity index and site-specific adaptation and evaluation using crop coefficients. Water management and planning applications at the water district scale include riparian and groundwater-dependent vegetation consumptive use monitoring, inputs to groundwater basin models, and estimates of the ET of applied water. A range of CalETa applications and its benefits, from supporting farmers to regional water balance studies, will be presented.

The figure below is one example demonstrating the utility of the CalETa dataset in water resource management. Consumptive almond water use across the Turlock Lake Detailed Analysis Unit (DAU) for calendar year 2014 was estimated for 1,190 almond fields covering 60,026 acres. The average annual ETa (black curve) for each field from the CalETa dataset is arranged in descending order. The

variability of ETa at the field scale is illustrated with the 95th percentile of ETa (green curve). The mean of the field average ETa and mean of the 95th percentile of field ETa were 40.1 and 49.6 inches, respectively. In contrast, the annual crop ET estimate (ETc) was 54.9 inches. In this example, ETc overestimated average annual ETa by approximately 37%, demonstrating the need to characterize the spatial variability of crop water consumptive use.



2014 Consumptive Almond Water Use, Turlock Lake Detail Analysis Unit

2. A Comparative Study for Estimating Crop Evapotranspiration in the Sacramento-San Joaquin Delta

Presenter(s): Josué Medellín-Azuara (UC Merced)
Presenter(s) Email Address(es): jmedellin-azuara@ucmerced.edu
Collaborators: Jesse Jankowski, Kyaw Tha Paw U, Yufang Jin, Jay Lund, Andrew Bell, Eric Kent, Jenae' Clay, Andy Wong, Nicholas Santos, Jessica Badillo, Jean-Jacques Lambert, Megan McAuliffe, David Edgar, Sean Freiberg, Ruolan Gong, Megan Metz, Quinn Hart, Nadya Alexander, Justin Merz, J. Andrés Morandé, Rex Piles, (UC Davis); Andreas Anderson, Joshua Viers, YangQuan Chen (UC Merced); Michelle Leinfelder-Miles, Richard Synder (UC Cooperative Extension); Cayle Little, Bekele Temegsen, Morteza Orang, Sara Sarreshteh, Simon Eching, Tariq Kadir, Lan Liang, Ricardo Trezza (DWR); Martha Anderson, Thomas Trout (USDA); Daniel Howes (Cal Poly); Forest Melton, Alberto Guzmán, Lee Johnson, Carolyn Roosevelt, Kirk Post (NASA & CSUMB); Richard Allen (UI); Byron Clark (Davids Engineering)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Understanding consumptive water use the Sacramento-San Joaquin Delta through evapotranspiration (ET) is critical for resource management, water rights administration, and environmental and water quality protection. This study compares ET estimates across the Delta from seven methods for the 2015 and 2016 water years, along with measurement-based ET estimates at 19 field stations in four different crops. Model input datasets and outputs were standardized where possible and compiled in Google Earth Engine to compare results on multiple scales. These include overall agricultural ET volumes for the Delta, average monthly ET rates by land use, spatial and temporal analysis of variations between models, regional ET trends, reference evapotranspiration sources, and calculated crop coefficients.

Detailed parcel-scale daily comparisons between similar methods and the field-based estimates helped identify key methodological differences and prospects for convergence. ET results for the Delta are consistent with water balance estimates in the California Water Plan, and all seven methods were within 10% of the mean estimate. Increased fallowing of land caused decreased ET from 2015 to 2016, with the majority coming from alfalfa, corn, and pasture. Field-based ET estimates in bare soil, alfalfa, corn, and pasture were generally lower than ET estimates, suggesting localized microclimates not captured by remote sensing may impact ET. This study has important implications for water management in the Delta, and the combination of remote models and field measurements may eventually substitute for water use reporting and be used to evaluate water transfers or natural vegetation restoration. Regional ET estimates may inform groundwater regulations and other hydrodynamic and water quality models, and estimates will help inform long-term operations and planning in the Delta. Additional conclusions on ET estimation, policy recommendations, and technical details about models are also provided.

3. Estimating the Impact of Land Use Change on Delta Consumptive Use using DETAW v2.0
Presenter(s): Lan Liang (DWR)
Presenter(s) Email Address(es): lan.liang@water.ca.gov
Collaborators: Tariq Kadir (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Delta Evapotranspiration of Applied Water (DETAW) model v2.0 was one of seven models presented in a study organized by the Delta Watermaster and UC Davis to compare models for estimating evapotranspiration (ET) in the Sacramento-San Joaquin Delta. ET was estimated for both 2015 and 2016, years for which Delta land use surveys were conducted in order to assess the impacts of crop idling in 2016 to reduce Delta consumptive use. DETAW v2.0 was used to also analyze impacts of crop idling on ET for different regions in the Delta. Furthermore, DETAW's input data series, including annual land use and daily temperatures, were expanded to enable modeling of Delta ET from 1922 through the present. The ET modeling of this extended period shows how land use changes over time have impacted consumptive use in various regions of the Delta.

4. Google Earth Engine METRIC (GEM) Application for Remote Sensing of Evapotranspiration
Presenter(s): Nicholas Santos (UC Davis)
Presenter(s) Email Address(es): nadyadaniela@gmail.com or nrsantos@ucdavis.edu
Collaborators: Nadya Alexander, Andrew Bell, Justin Merz, Quinn Hart, George Scheer (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
For the past ten years the METRIC algorithm (Allen et al., 2007) has been used across a wide range of research and consulting applications to estimate evapotranspiration (ET), mostly in crops employing inputs of Landsat satellite imagery, crop layer data, and local weather stations. The METRIC algorithm has been extensively researched and tested for accuracy, but running its various steps and troubleshooting can be time-consuming. We present an application of METRIC using Google Earth Engine (GEM) developed at the Center for Watershed Sciences at UC Davis which contributes to the advancement of existing METRIC processing platforms. The GEM platform dramatically reduces processing time and provides diagnostic data tools for fine-tuning. The application incorporates modules for a QA/QC process on weather data, calculation of grass-based and alfalfa-based reference ET, built-in cloud masking and thermal sharpening, spatial tabulation for hot and cold pixel selection, easily adjustable parameters, and statistical analysis of calibration decisions. The ease and speed of

running the GEM application allows for METRIC results to be presented with a wider range of sensitivity analyses than previous versions. Results and model inputs enhance transparency and replicability in some key METRIC model elements, including the hot and cold pixel calibration. The GEM application has been employed at UC Davis to estimate ET and vegetative indices in various applications in the Central Valley, Kern County, and the Sacramento-San Joaquin Delta. The open-source GEM application combines the speed and flexibility of Google Earth Engine-based remote sensing cloud processing with the transparency and customization desirable for research.

5. Mapping Evapotranspiration in the Sacramento-San Joaquin Delta Using Simulated ECOSTRESS Thermal Data - Validation and Inter-Comparison

Presenter(s): Andy Wong (UC Davis)
Presenter(s) Email Address(es): ajywong@ucdavis.edu
Collaborators: Yufang Jin, Eric Kent, Kyaw Tha Paw U, Jay Lund (UC Davis); Ruyan He (China University of Mining & Technology, Beijing); Joshua B. Fisher, Glynn Gulley, Gerardo Rivera, Christine Lee, Simon Hook (Caltech); Josué Medellín-Azuara (UC Merced); Feng Gao (USDA)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Most consumptive crop water use returns to the atmosphere through evapotranspiration (ET). In California, where our water resources are limited and heavily utilized, the need for a cost-effective, timely, and consistent spatial estimate of crop ET, from the farm to watershed level, is becoming increasingly important. The ECOSTRESS mission, measuring the most detailed and accurate temperature ever acquired from space, provides unique opportunities for estimating ET at the farm-scale. We simulated ECOSTRESS thermal data using VIIRS and Landsat data in the Sacramento-San Joaquin Delta for the 2016 water year. Three remote sensing-based ET methods were then applied to estimate ET using simulated ECOSTRESS data and optical data from Landsat and VIIRS: Priestley-Taylor applications developed by NASA's Jet Propulsion Laboratory (PT-JPL) and UC Davis (PT-UCD), as well as an implementation of the METRIC model by UC Davis (METRIC-UCD). We compared these three sets of ET estimates with field measurements at sixteen sites over five crop types, and good agreement was found between satellite-based estimates and field measurements. Our results demonstrate that thermal data from the upcoming ECOSTRESS mission will reduce the uncertainty in remotely sensed ET estimates. A continuous monitoring of the dynamics and spatial heterogeneity of consumptive water use at a field scale will inform decisions in both regional and field-scale water resource management.

Session 19. Poster Session

1. Real-time Ensemble Flow Forecasts for a 2017 Mock Operation Test Trial of Forecast Informed Reservoir Operations for Lake Mendocino in Mendocino County, California

Presenter(s): Chris Delaney (Sonoma County Water Agency)
Presenter(s) Email Address(es): Chris.Delaney@scwa.ca.gov
Collaborators: John Mendoza (Sonoma County Water Agency), Brett Whitin (California Nevada River Forecast Center), Robert Hartman (Consultant), Julie Kanansky (Center for Western Weather Water Extremes), Dave Reynolds (Cooperative Institute for Research in Environmental Sciences)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Forecast informed reservoir operations (FIRO) is a methodology that incorporates precipitation and flow forecasts to inform the flood operations of reservoirs. The Ensemble Forecast Operations (EFO)

alternative is a probabilistic approach of FIRO that incorporates 15-day ensemble streamflow predictions (ESPs) made by NOAA's California-Nevada River Forecast Center (CNRFC). With the EFO approach, release decisions are made to manage forecasted risk of reaching critical operational thresholds. A water management model was developed for Lake Mendocino, a 111,000 acre-foot reservoir located near Ukiah, California, to conduct a mock operation test trial of the EFO alternative for 2017. Lake Mendocino is a dual use reservoir, which is owned and operated for flood control by the United States Army Corps of Engineers and is operated for water supply by the Sonoma County Water Agency. Due to recent changes in the operations of an upstream hydroelectric facility, this reservoir has suffered from water supply reliability issues since 2007. The operational trial utilized real-time ESPs prepared by the CNRFC and observed flow information to simulate hydrologic conditions in Lake Mendocino and a 50-mile downstream reach to the City of Healdsburg. Results of the EFO trial demonstrate a 6% increase in reservoir storage at the end of trial period (May 10) relative to observed conditions. Additionally, model results show no increase in flows above flood stage for points downstream of Lake Mendocino. Results of this investigation and other studies demonstrate that the EFO alternative may be a viable flood control operations approach for Lake Mendocino.

2. Projected Changes in Precipitation, Temperature, and Drought across California's Hydrologic Regions in the 21st Century

Presenter(s): Minxue (Kevin) He, California Department of Water Resources
Presenter(s) Email Address(es): kevin.he@water.ca.gov
Collaborators: Andrew Schwarz, Elissa Lynn, Michael Anderson, Jamie Anderson
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:

This study investigates potential changes in future precipitation, temperature, and drought across 10 hydrologic regions in California. The latest climate model projections on these variables through 2099 representing the current state of the climate science are applied for this purpose. Changes are explored in terms of differences from a historical baseline as well as the changing rate (trend). Results indicate that warming is expected across all regions in all temperature projections, particularly in late century when more than 3.5 °C warming is projected statewide. There is no such consensus in precipitation, with projections ranging from -25 percent to +50 percent different from the historical baseline. There is no statistically significant increasing or decreasing trend in historical precipitation and in a majority of the projections of precipitation. But, on average, precipitation is expected to increase slightly for most regions. Compared to wet regions, dry regions are projected to have higher increases in temperature and more severe droughts. The study also shows that the North Lahontan region tends to have the highest increases in both minimum and maximum temperature and a significant amount of increase in wet season precipitation, indicative of increasing flood risks in this region. For the driest region, the Colorado River region, all projections consistently show higher increasing trends in temperature and drought risk compared to their historical counterparts.

3. Climate Change Impacts on Central Valley and San Francisco Bay-Delta Estuary Flows

Presenter(s): Minxue (Kevin) He, California Department of Water Resources
Presenter(s) Email Address(es): kevin.he@water.ca.gov
Collaborators: Andrew Schwarz, Patrick Ray, Sungwook Wi, Casey Brown, Elissa Lynn
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:

The health of San Francisco Estuary's ecosystem largely relies on outflow from the Sacramento-San Joaquin Delta which in turn is influenced by the State Water Project (SWP). Climate change induced

changes in precipitation, warming, and Sea Level Rise (SLR) will change the amount of streamflow entering the Delta and Estuary, the timing of that streamflow, and the salinity and ocean boundary conditions of the Estuary. The goal of this study is to assess the impacts of those potential changes in precipitation, temperature, and sea level on critical operational metrics including annual SWP deliveries, Lake Oroville storage, and seasonal net Delta outflow. An innovative bottom-up decision scaling approach is adopted for this purpose. The approach identifies possible variation ranges of climatic variables from downscaled Global Circulation Model (GCM) projections. Specifically, the potential range of temperature change is explored by increasing mean temperature in 0.5°C increments from 0°C to 4°C (nine scenarios). Potential change in precipitation is explored from -30% to 30% in 10% increments (seven scenarios). Three SLR conditions are considered, no rise, 15 cm rise, and 45 cm rise. A hydrologic model and a water system model are run sequentially to simulate aforementioned operational metrics under those climate change scenarios. Model results indicate that both SLR and warming would reduce SWP annual deliveries. While SLR shows no clear impact on Lake Oroville storage, warming would lead to declined storage. As expected, increasing (decreasing) precipitation would increase (decrease) SWP annual deliveries and Lake Oroville Storage. Increases (decreases) in precipitation also increase (decrease) seasonal net Delta outflow. However, warming shows nonhomogeneous (across different warming scenarios in different seasons) impacts on net Delta outflow. Compared to warming, SLR exhibits less significant impact on net Delta outflow. Overall, this study has significant scientific and practical implications, in the context of providing an innovative framework to assess the resilience of the current water system to climate change and guide operational climate science informed planning and adaptation activities in the Estuary.

4. A Comparative Study of Consumptive Water Use in the Sacramento-San Joaquin Delta

Presenter(s): Jesse Jankowski (Center for Watershed Sciences, University of California Davis)
Presenter(s) Email Address(es): jjankowski@ucdavis.edu
Collaborators: Josué Medellín-Azuara (UC Merced); Kyaw Tha Paw U, Yufang Jin, Jay Lund, Andrew Bell, Nicholas Santos, Eric Kent, Jenae' Clay, Jessica Badillo, Nadya Alexander, Andy Wong, & J. Andres Morande (UC Davis); Martha Anderson (USDA-ARS); Alberto Guzman, Lee Johnson, Forrest Melton, & Carolyn Roosevelt (NASA-ARC & CSU Monterey Bay); Daniel Howes (ITRC at Cal Poly SLO); Tariq Kadir, Lan Liang, Morteza Orang, & Cayle Little (DWR); Michelle Leinfelder-Miles (UC Cooperative Extension)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Understanding consumptive water use the Sacramento-San Joaquin Delta through evapotranspiration (ET) is critical for resource management, water rights administration, and environmental and water quality protection. This study compares ET estimates across the Delta from seven methods for the 2015 and 2016 water years, along with measurement-based ET estimates at 19 field stations. Model input datasets and outputs were standardized where possible and compiled in Google Earth Engine to compare results on multiple scales. These include overall agricultural ET volumes for the Delta, average monthly ET rates by land use, spatial and temporal analysis of variations between models, regional ET trends, reference evapotranspiration sources, and assumed crop coefficients. Detailed parcel-scale daily comparisons between similar methods and the field-based estimates helped identify key differences and prospects for convergence. ET results for the Delta are consistent with water balance estimates in the California Water Plan, and all seven methods were within 10% of the mean estimate. Increased fallowing of land caused decreased ET from 2015 to 2016, with the majority coming from alfalfa, corn, and pasture. Field-based ET estimates in bare soil, alfalfa, corn, and pasture were generally lower than ET estimates, suggesting localized microclimates not captured by remote sensing may impact ET. This study has important implications for water management in the Delta, and the combination of remote models and field measurements may eventually substitute for water use

reporting and be used to evaluate water transfers or natural vegetation restoration. Regional ET estimates may inform groundwater regulations and other hydrodynamic and water quality models, and estimates will help inform long-term operations and planning in the Delta. Additional conclusions on ET estimation, policy recommendations, and technical details about models are also provided.

5. Visualization and Calibration of IWFM Applications in 3D using GroundwaterDesktop
Presenter(s): Marinko Karanovic (S.S. Papadopulos & Associates, Inc. (SSP&A))
Presenter(s) Email Address(es): karanovicm@sspa.com
Collaborators: Matthew J. Tonkin (SSP&A)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
GroundWater Desktop (GWD) is a fully three-dimensional (3D) data visualization and simulation model post-processing tool developed to support both structured and unstructured model grid formats, including finite elements. Although originally developed to support MODFLOW-platform models – including the unstructured MODFLOW-USG format – GWD was in recent years extended to support models developed using the California Department of Water Resources (CDWR) Integrated Water Flow Model (IWFM) code. As such, GWD is now capable of importing models constructed using the IWFM code, and visualizing the simulation aquifer and stream-related parameters, boundary conditions, and simulation results, together with groundwater pumping and observation well locations and time-series data and other 3D data within an intuitive user environment. In doing so, GWD can greatly facilitate the calibration of models developed using the IWFM code by plotting measured and simulated time-series (hydrographs) for groundwater heads and for streamflows. The 3D visualization capability empowers model application developers and reviewers the capability to rotate, slice and dice models, data, and results dynamically. GWD is under continual development to add features and capabilities that support IWFM model applications.

6. Evapotranspiration Estimation from Unmanned Aerial Vehicle Imagery
Presenter(s): Jorge Andres Morande (Center for Watershed Sciences, University of California Davis)
Presenter(s) Email Address(es): jmorande@ucdavis.edu
Collaborators: Ricardo Trezza (DWR), Andreas Anderson, Yangquan Chen, Josh Viers, Josué Medellín-Azuara (UC Merced), Kyaw Tha Pay U, Yufang Jin, Jessica Badillo, and Jesse Jankowski (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
A preliminary study was conducted by UC Davis to estimate evapotranspiration (ET) from alfalfa, corn, and pasture fields in the Sacramento-San Joaquin Delta using fine spatial and temporal resolution data collected by Unmanned Aerial Vehicles (UAVs). Thermal and multispectral data were used as inputs to the METRIC model developed by Allen et al. (2007) to develop ET estimates, and flights were made concurrent with Landsat 8 overpasses so that results could be compared to remotely-sensed estimates made by the default METRIC model. Concurrent field-based estimates from surface renewal stations deployed by UC Davis were also compared. Mean daily ET estimates from the UAV-based model were reasonably consistent with remotely-sensed estimates, averaging an absolute difference of about 2.5% across all three crops. Instantaneous UAV-based ET estimates were predominantly lower than the ground-based estimates for all three crops, with and average difference of 5.9% across all three crops. UAV technology shows promise for estimating ET at a field-scale, but appropriate protocols need to be developed for increasing consistency in measurements and estimation using the images obtained.

7. Interpretation and Implementation of the 1969 Colorado Water Law and its Relevance to the 2014 Sustainable Groundwater Management Act
Presenter(s): Hubert Morel-Seytoux (Hydroprose International Consulting)
Presenter(s) Email Address(es): hydroprose@sonic.net
Collaborators: n/a
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
In 1969 the Colorado legislature changed the water law requiring that surface and ground waters be adjudicated and administered jointly. It essentially curtailed the unlimited use of groundwater when in connection with streams. The 2014 SGMA has the potential to do the same. However, the intent was different. In Colorado the intent was to protect (surface) water rights. In California it is to make the use of groundwater sustainable in the long term.

8. Accurate and Efficient Modeling of Alternating Sequences of Saturated and Unsaturated Seepage
Presenter(s): Hubert Morel-Seytoux (Hydroprose International Consulting)
Presenter(s) Email Address(es): hydroprose@sonic.net
Collaborators: Rien van Genuchten
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
The connection between a stream and an aquifer, which previously were in saturated hydraulic connection, may become unsaturated as a result of significant groundwater drawdowns in the vicinity of the river. To estimate the amount of seepage from the river it becomes necessary to account for unsaturated flow. One could use a numerical solution of a multidimensional highly nonlinear unsaturated flow system of equations. However, this is computationally very costly and unpractical for large-scale regional problems. This article describes a fairly simple analytical procedure to calculate the flow exchange between the river and the aquifer. Though partially approximate, the solution is sufficiently accurate because it conserves mass balance and maintains the essential dynamic character of the process. An example illustrates the procedure.

9. Data Needs for Using Water Quality Models to Establish Nutrient Goals
Presenter(s): Tad Slawecki (LimnoTech)
Presenter(s) Email Address(es): tad@limno.com
Collaborators: Dr. David Dilks, Todd Redder, Derek Schlea, Scott Hinz, Penelope Mosku (LimnoTech); Dr. Steven Chapra (Tufts)
Permission to Post pdf of Presentation on CWEMF Website: yes
Abstract:
The development of scientifically sound nutrient goals, such as numeric nutrient criteria or allowable loads, is a high-profile challenge facing states and the regulated community. Mechanistic water quality models provide one potential method for defining appropriate nutrient targets that consider site-specific characteristics, but some well-scoped applications were not successful in setting final nutrient targets due to model uncertainty caused by data limitations.

This Water Research Foundation-funded project helps both regulators and affected parties understand the amount of data required to develop a water quality model for nutrients that can support management actions based on:

- Review of existing nutrient modeling studies to assess the relationship between amount of data available and regulatory success
- Examination of data-rich case studies to establish the relationship between amount of data available and model reliability
- Development of practical methods for assessing model uncertainty
- Assessment of requirements for regulatory acceptance

To date, we have reviewed 40 nutrient modeling applications, categorized them by various aspects of data availability, and developed correlations to define the factors most important to their regulatory success (and failure). We have also performed jackknife uncertainty analyses on certain model applications to define the effect of additional years of data collection on model uncertainty, finding that calibration to limited data sets tended to generate better error statistics, but that model prediction uncertainty was much greater with limited data sets.

10. Calibration of a Hydrologic Model Using Spatially Distributed Evapotranspiration
Presenter(s): Mohammad Sohrabi (UC Merced)
Presenter(s) Email Address(es): msohrabi2@ucmerced.edu
Collaborators: Mohammad Safeeq (UC Merced), Martha Conklin (UC Merced)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Accurate headwater modeling is critical for water resources planning and management. This study uses an innovative hydrologic model calibration using spatially distributed annual evapotranspiration (ET), as opposed to using discharge, to improve model performance. To do this, we ran Precipitation-Runoff Modeling System (PRMS) that was coupled with a process-based snow model (SnowModel) for water years 2000-2014 at 800 m spatial resolution over the Kings River Basin with drainage area of 3996 km2. After adjusting PRMS for potential ET and solar radiation index, we calibrated the model using two different approaches for performance evaluation. In the first approach, we calibrated and validated PRMS for annual average ET for water years 2005-2007 and 2010-2012, respectively. For the second approach, we calibrated and validated the model for discharge at the basin outlet using full natural flow for water years 2000-2009 and 2010-2014, respectively. The results of the first approach showed that <1% of grid cells in the calibrations and validation periods showed an unsatisfactory (PBIAS ≤ -25% or PBIAS ≥ 25%) performance in reproducing the ET. In contrast, about 80% of grid cells had unsatisfactory performance in simulating ET using the second calibration approach. We further evaluated these two calibration approaches with observed monthly ET at two flux towers and found average correlation of 0.79 (first approach) and -0.06 (second approach) between the predicted and observed ET. Model performances in terms of streamflow using the two calibration approaches were similar (correlation >0.88). The results indicate that a hydrologic model that is calibrated using merely discharge cannot accurately represents other hydrological processes, particularly in large basins. This type of calibration approach results in cascades of unrealistic but compensatory parameters values to generate the best predictions of streamflow relative to the observed values. The results indicate that spatially distributed ET can be incorporated for model calibration to better capture the spatiall variability of hydrological fluxes, particularly in places like California with diverse vegetation cover.

11. Complex Cascading Dam Breach Analysis using HEC-RAS 2D
Presenter(s): Eric Toth (East Bay Municipal Utility District)
Presenter(s) Email Address(es): eric.toth@ebmud.com
Collaborators: Priyanka Jain (East Bay Municipal Utility District)

Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The East Bay Municipal Utility District (EBMUD) is updating its dam breach inundation maps for all of their reservoirs in the east bay area. This poster showcases the complex dam breach analysis using HEC-RAS 2D for Upper San Leandro Dam (USL), which involved hypothetically breaching three dams in series under a Probable Maximum Flood scenario.

12. Master Middle Ware: A Tool to Integrate Water Resources and Fish Population Dynamics Models

Presenter(s): Sooyeon Yi (University of California Berkeley), Lisa Thompson (Sacramento Regional County Sanitation District)
Presenter(s) Email Address(es): sooyeon@berkeley.edu, thompsonlis@sacsewer.com
Collaborators: Samuel Sandoval Solis (University of California Davis), David Patrick Kilduff (University of California Davis)
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:
Linking models that investigate separate components of ecosystem processes has the potential to unify messages regarding management decisions by evaluating potential trade-offs in a cohesive framework. This project aimed to improve the ability of riparian resource managers to forecast future water availability and resultant fish habitat suitability, to better inform management decisions. We developed a middleware tool to link and oversee the operations of two existing models, a water resource planning tool Water Evaluation and Planning (WEAP) and a habitat-based fish population dynamics model (WEAPhish). First, we designed the Master Middle Ware (MMW) software in Visual Basic for Application® in one Excel® file that provided a familiar framework for data input and output. Second, MMW was used to link and jointly operate WEAP and WEAPhish, using Visual Basic Application (VBA) macros to implement system level calls to run the models. To demonstrate the utility of this approach, we developed hydrological, biological, and middleware model components for the Butte Creek basin. This tributary of the Sacramento River, California is managed for both hydropower and the persistence of a threatened fish population. MMW can be customized for different rivers and fish populations, assuming basic data requirements are met. This model integration improves on ad hoc linkages for managing data transfer between software programs by providing a consistent, user-friendly interface across different model implementations. Furthermore, the data-viewing capabilities of MMW facilitate the rapid interpretation of model results by hydrologists, fisheries biologists, and resource managers, to accelerate learning and management decision making.

13. Modeling Nitrogen Cycling in Suisun Bay and Delta

Presenter(s): Zhenlin Zhang (SFEI)
Presenter(s) Email Address(es): zhenlinz@sfei.org
Collaborators: Rusty Holleman; David Senn (SFEI)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
As the first step of biogeochemical model development for Delta/Suisun Bay, we focused our effort on resolving nitrification and denitrification processes in Delta/Suisun Bay, using a finite volume biogeochemical transport & cycling model DWAQ (Deltares Water Quality) and three-dimensional hydrodynamic output from DFM (Deltares Flexible Mesh). The modelling results show that the modelled dissolved nitrate and dissolved ammonia match well broadly with the discrete sampled data

across the Delta, even though at this stage processes associated with organic nitrogen (production, grazing and mineralization) have not be implemented. We demonstrated that the model can be used as a useful tool to derive important information of the system, such as source water composition and water age by applying conservative tracer runs. We can also run future and management scenarios to investigate the outcome of certain management actions: such as planned Sac Regional wastewater treatment plant upgrade.

Session 20. C2VSim Update – Part 2

1. Land Use Development for the C2VSim Update

Presenter(s): Tyler Hatch (California Department of Water Resources)
Presenter(s) Email Address(es): tyler.hatch@water.ca.gov
Collaborators: Can Dogrul (California Department of Water Resources); Dominick Amador (Woodard & Curran)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Land use data is an important input to C2VSim for estimating water demands. For the C2VSim Update, land use distributions were developed for each simulation year for each element in the model. Additional enhancements of the land use data included expansion of the land use categories from 17 categories to 25 categories (20 agricultural crop categories consistent with the California Water Plan), extension of the data to Water Year 2015, and the addition of spatial data from multiple sources including DWR County, DWR LandIQ 2014, DWR 1960, CVPIA Refuges, Kern County, and USDA CDL. In many years, the central valley land use coverage was not complete so the gaps were filled utilizing DAU County estimates developed for the California Water Plan and supplemental information for the non-agricultural lands. The tool used to fill the gaps was the IWFM utility program called LUEXINT. One key limitation of the land use data is the use of categories that represent a single crop for each year. However, the methodology used to develop the land use coverage allows a user to make localized edits to selected areas in the model domain. This can allow field-scale corrections to be made as new or better information becomes available.

2. Application of IDC for Water Management in California, Including Update of C2VSim

Presenter(s): Byron Clark (Davids Engineering) and Dominick Amador (Woodard & Curran)
Presenter(s) Email Address(es): byron@davidsengineering.com, damador@woodardcurran.com
Collaborators: Mesut Cayar (W&C), Vivek Bedakar (SSPA), Can Dogrul (DWR), Charlie Brush (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The IWFM Demand Calculator (IDC) is a powerful tool to simulate land and water use processes and is increasingly being used to support water budget analyses for Agricultural Water Management Plans (AWMPs) and Groundwater Sustainability Plans (GSPs). This presentation will provide a brief overview of processes simulated by IDC, a summary of IDC applications developed to support water management in California, and a description of the update of IDC for C2VSim currently underway.

Discussion of IDC applications will include a description of alternative approaches to parameterizing IDC, data sources, calibration approaches, and uses of application results. Discussion of the C2VSim update will include a description of data sources relied upon, approach to developing input parameters, and comparisons of preliminary results to estimates of agricultural demands from independent sources, including CalSimETAW, the CalAG model, and local studies.

3. Use of Automated Calibration with IWFM-IDC Models: Examples from C2VSIM and SVSIM Applications

Presenter(s): Matthew J. Tonkin, Vivek Bedekar (S.S. Papadopulos & Associates, Inc. (SSP&A))
Presenter(s) Email Address(es): matt@sspa.com, vivekb@sspa.com
Collaborators: Tim Durbin (Timothy J. Durbin, Inc.), Linda Bond (California Department of Water Resources), Marinko Karanovic (SSP&A), Leland Scantlebury (SSP&A), Mesut Cayar (RMC/WC), Dominick Amador (RMC/WC), Byron Clark (Davids Engineering), Can Dogrul (CDWR), Charlie Brush (CDWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Calibration of IWFM/IDC applications using PEST is supported by a suite of custom utilities. Recently, PEST was used to calibrate the groundwater and root-zone/demand components of the Sacramento Valley Simulation Model (SVSim) and fine and coarse versions of the Central Valley Simulation Model (C2VSim-FG and C2VSim-CG). For the root-zone/demand components, a holistic approach was taken to calibrate IDC parameters and provide pumping and deep percolation rates. Independent ET estimates were used to constrain ET requirements, and agricultural demands obtained from the Cal-Ag and CalSIMETAW models were used as targets in both annual and seasonal (irrigation / non-irrigation) calibrations. ET and applied water estimates for ponded agriculture posed challenges requiring two approaches: first, a heuristic approach to a-priori identify model elements as fully, partially or non-ponded; and second, a new formulation added to the IDC to accommodate ponded agriculture in mixed land-use elements enabling assignment of a separate hydraulic conductivity for ponded-agriculture. For the groundwater component, a new utility was developed to calibrate aquifer parameters using a combination of sediment texture data and pilot points. This is accomplished by translating texture data into estimates of hydraulic conductivity and storage using end-member values for fine and coarse material with power-law relationships to interpolate between these bounds while preserving the 3D texture distribution (Durbin et al., 2017). The utility *Soil2AquiferPar* reads the bounding values for fine and coarse material and the percent of coarse texture in each well, and applies power-law relations to compute aquifer parameter values and interpolate these to the IWFM nodes using pilot points. The approach provides a physically-based yet parsimonious basis to estimate heterogeneous parameters. Although *Soil2AquiferPar* was developed for these three applications, it can be applied to *any* IWFM application.

4. Application of C2vSim for Groundwater Sustainability Analysis and GSP Development Support

Presenter(s): Ali Taghavi
Presenter(s) Email Address(es): ataghavi@woodardcurran.com
Collaborators: Abdul Khan, Tyler Hatch, Saquib Najmus, Mesut Cayar, Jim Blanke, Dominick Amador, Sara Miller, Frank Qian
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The California Central Valley Simulation Model (C2VSim) has been developed by the Department of Water Resources (DWR) for assessment of the historical, current, and possible future groundwater conditions in the Central Valley of California. An enhanced version of the model with much finer finite element network has been developed to support groundwater sustainability analysis at a groundwater subbasin scale. This version of the model is calibrated for the water years 1970-2015; however, the model possesses a much longer hydrologic period of water years 1922-2015, which can be used for evaluation of long-term conditions.

The model has been developed in a collaborative manner and is intended to be used by the local Groundwater Sustainability Agencies (GSA) in the Central Valley. The presentation will discuss the use and application of the model in areas such as:

- Support in development of water budgets for each subbasin for recent historical conditions, as well as current and future conditions.
- Support in evaluation of water management options that would result in a sustainable groundwater conditions. This type of analysis can include both demand-side and supply-side water management options.
- Providing information on interbasin boundary flows to support interbasin agreements

Session 21. University Engagement on California Water Problems

1. Calibration of a Hydrologic Model using Spatially Distributed Evapotranspiration

Presenter(s): Mohammad Sohrabi (UC Merced)
Presenter(s) Email Address(es): msohrabi2@ucmerced.edu
Collaborators: Mohammad Safeeq (UC Merced), Martha Conklin (UC Merced)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Accurate headwater modeling is critical for water resources planning and management. This study uses an innovative hydrologic model calibration using spatially distributed annual evapotranspiration (ET), as opposed to using discharge, to improve model performance. To do this, we ran Precipitation-Runoff Modeling System (PRMS) that was coupled with a process-based snow model (SnowModel) for water years 2000-2014 at 800 m spatial resolution over the Kings River Basin with drainage area of 3996 km2. After adjusting PRMS for potential ET and solar radiation index, we calibrated the model using two different approaches for performance evaluation. In the first approach, we calibrated and validated PRMS for annual average ET for water years 2005-2007 and 2010-2012, respectively. For the second approach, we calibrated and validated the model for discharge at the basin outlet using full natural flow for water years 2000-2009 and 2010-2014, respectively. The results of the first approach showed that <1% of grid cells in the calibrations and validation periods showed an unsatisfactory (PBIAS ≤ -25% or PBIAS ≥ 25%) performance in reproducing the ET. In contrast, about 80% of grid cells had unsatisfactory performance in simulating ET using the second calibration approach. We further evaluated these two calibration approaches with observed monthly ET at two flux towers and found average correlation of 0.79 (first approach) and -0.06 (second approach) between the predicted and observed ET. Model performances in terms of streamflow using the two calibration approaches were similar (correlation >0.88). The results indicate that a hydrologic model that is calibrated using merely discharge cannot accurately represents other hydrological processes, particularly in large basins. This type of calibration approach results in cascades of unrealistic but compensatory parameters values to generate the best predictions of streamflow relative to the observed values. The results indicate that spatially distributed ET can be incorporated for model calibration to better capture the spatial variability of hydrological fluxes, particularly in places like California with diverse vegetation cover.

2. Davis Manor Green Infrastructure Modeling

Presenter(s): John Heltzel (CSU Sacramento)
Presenter(s) Email Address(es): john.heltzel@owp.csus.edu
Collaborators: Dr. John Johnston (CSU Sacramento), Dr. Erik Porse (CSU Sacramento)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Abstract:
Urban stormwater management traditionally used gutters and collection pipes to manage runoff. Today, cities look to use green infrastructure strategies to reduce flow volumes and velocities, preventing runoff from getting to downstream watersheds. Urban hydrologic modeling is essential in designing systems that mitigate flood risks and ecosystem impacts while also promoting groundwater infiltration. Davis Manor, a neighborhood within the City of Davis, is currently evaluating the feasibility of installing green infrastructure, including rain gardens and permeable pavers, to reduce its contribution to urban runoff. In support of this design process, the project focused on developing an analysis using EPA's Stormwater Management Model (SWMM) to translate conceptual plans for green infrastructure implementation into engineering designs. Using SWMM, analysis assessed runoff volumes from sub-catchments within the neighborhood and the treatment capacity of the proposed green infrastructure. Data provided by the City of Davis, along with Google imagery, Street View, and field surveys, were used to determine sub-catchment characteristics such as connectivity, imperviousness, slopes, and existing vegetation. The SWMM model developed as a result of this project evaluates alternative scenarios that optimize the type and location of stormwater infrastructure for alternative goals of minimizing the loss of parking spaces while maximizing capacity to effectively manage and treat stormwater.

3. Policy Insights from Comparing Evapotranspiration Estimates in the Sacramento-San Joaquin Delta

Presenter(s): Jesse Jankowski (UC Davis)
Presenter(s) Email Address(es): jjankowski@ucdavis.edu
Collaborators: Josue Medellin (UC Merced), Jay Lund (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
This study explores lessons learned for policy from a comparative study on crop consumptive use as evapotranspiration (ET) in the Sacramento-San Joaquin Delta (SSJD). Seven methods for estimating ET including crop coefficients and remote sensing, and measurements from surface renewal and eddy covariance stations deployed in the SSJD were employed in this comparison. Results from this 2015-2016 study show that there is a general agreement on the total consumptive use in the SSJD from crops with a median estimate of 1.45 MAF/year in 2015 and 1.28 MAF in 2016. While the aggregate of ET is broadly consistent across models, some discrepancies remain unresolved between field-based ET estimates and modeled ET estimates highlighting potential areas, which would benefit from additional research and standardization across models and field measurements. Some policy insights include: 1) the significance of idle land contribution to ET, 2) the need for long term land use programs, 3) cost-effectiveness in estimating ET through remote sensing, and 4) the usefulness of ET estimation in planning and water management.

4. Random Is Not Unbiased: Rethinking Cross Validation Strategies

Presenter(s): Ellie White (UC Davis)
Presenter(s) Email Address(es): white.elaheh@gmail.com
Collaborators: Jay Lund (UC Davis), Jon Herman (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Statistical learning allows for the semi-automated creation of complex water resources models with many interacting predictor variables to improve prediction. Most statistical learning techniques, used in water resources modeling, employ a randomized splitting of the data into k-folds to avoid

overfitting. In each iteration, one fold is held out as a test set and others are designated the training set. Such random cross validation (CV) methods ignore structures in the data, which lead to an underestimation of model error. Also, models built with randomized CV methods violate the assumption of independence of residuals. When mapping the residuals in time or in space, the trends revealed point to dependence structures in the data that produce an over-fit model with non-causal parameters or missed meaningful parameters. The Leave-One-Group-Out Cross Validation (LOGO-CV) technique blocks training sets in time, space or unique structure (e.g., by hydrologic basins). The difficulty here lies in specifying block sizes. Blocking potentially reduces the range of parameters seen by the model, or may exclude a certain meaningful combination of predictor variables in the training dataset. Too small of a block size and the CV method more closely mimics the randomized method and runs the risk of under estimating model error. Too big of a block size and you are forcing too much extrapolation in the model and therefore run the risk of over estimating model errors. This paper compares a random CV strategy with the LOGO-CV strategy for modeling runoff. The latter method more accurately estimates the error in the Random Forest model (a regression tree based statistical learning algorithm).

Session 23. DSM2 Update

1. Martinez EC Estimation with DSM2-Extended Grid

Presenter(s): Ines Ferreira, California Department of Water Resources
Presenter(s) Email Address(es): ines.ferreira@water.ca.gov
Collaborators: Nicky Sandhu, California Department of Water Resources
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
DWR's Delta Modeling Section is developing an extension to the DSM2 grid from Martinez to the Golden Gate. The extension of the standard DSM2 grid is created with extensive and detailed geoprocessing of geometry data to properly account for the volume of water and salinity transported from the Golden Gate for Delta simulations. The current downstream stage and salinity boundary is affected by changes to inflow and structural changes such as flooding of islands and requires the use of scripts to estimate boundary conditions at Martinez. Setting the stage and salinity boundary at Golden Gate allows for studies to be run directly without the need for these pre-processing steps. Preliminary results show promise that this approach might be used in the future.

2. DSM2 Sediment Transport Model (DSM2-STM) Development

Presenter(s): En-Ching Hsu and Jamie Anderson
Presenter(s) Email Address(es): En-Ching.Hsu@water.ca.gov and Jamie.Anderson@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The ability to model turbidity and sediment transport in the Delta is important for effective management of Delta resources. The DSM2 Sediment Transport Model is a time-efficient tool to estimate the suspended sediment concentrations in the Sacramento-San Joaquin Delta. The sediment module is an extension of the DSM2 General Transport Model (DSM2-GTM) and has undergone a preliminary calibration with sediment data from 2010 to 2012 and validation for the period of 2012 to 2016. The model provides a systematic way to describe suspended sediment concentrations. There are ongoing efforts in extending this model to other constituents such as mercury. These components are essential in helping fulfill DWR's open-water compliance with the Delta Mercury Control Program.

3. Delta Channel Depletion Model

Presenter(s): Lan Liang and Bob Suits, California Department of Water Resources
Presenter(s) Email Address(es): Lan.Liang@water.ca.gov, Bob.Suits@water.ca.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Delta Channel Depletion Model (DCD), an extension of Delta Evapotranspiration of Applied Water v2.0 (DETAW v2.0), has been developed to estimate the daily historical channel depletions in the Sacramento-San Joaquin Delta. DETAW v2.0 simulates the effective applied waters, precipitations and seepages to meet the crop water demands of 168 subareas in the Delta. Based on these amounts, DCD estimates the actual Delta diversions, drainages and seepages along the channels with consideration of Lowlands subsurface water use, Uplands groundwater use and farming activities. Because many of these components cannot be measured directly or are unknown, DCD has been integrated with the Delta hydrodynamics model, Delta Simulation Model II(DSM2), to quantify the interactions of subsurface water, groundwater and surface water. This process takes advantage of the strong correlation between Delta outflow and salinity intrusion. With a resulting better understanding of Delta hydrology and the calibration and validation of the integrated model, the historical simulations of flow, EC and other water quality constituents in the Delta can be improved.

4. Suisun Marsh Salinity Control Gate Re-Operation Study Using DSM2

Presenter(s): Yu (Joey) Zhou, Minxue (Kevin) He (California Department of Water Resources)
Presenter(s) Email Address(es): yu.zhou@water.ca.gov, kevin.he@water.ca.gov
Collaborators: Eli Ateljevich, Nicky Sandhu (California Department of Water Resources)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
California Natural Resources Agency Delta Smelt Resiliency Strategy Proposed Action #4 calls for summer operation of the Suisun Marsh Salinity Control Gates (SMSCGs) to reduce salinity and improve habitat in the Marsh during summer months. The SMSCGs are typically operated from October to May. The proposed action includes additional gate operation in August. To evaluate the feasibility of implementing this action in Summer 2018, the DSM2 model is first set up for two historical surrogate years (above normal year 2005 and below normal year 2012) to assess the impact of the action on salinity conditions at key water quality compliance locations including the Jersey Point and Collinsville. The results show that gate re-operation in August increases salinity since mid-August through late October at Jersey Point. Increases in peak salinity range from 14%-18%. Salinity increase from September to early October in Collinsville is also evident. These findings indicate that additional summer outflow is required so that the proposed operation would not lead unintended salinity changes in the Delta. The model is further set up to forecast the impacts of gate re-operation in 2018 Summer, using hydrologic forecasts for the current year and facility operation configuration of previous similar years. Finally, water cost analysis is conducted to minimize the amount of outflow to offset the adverse impacts posed by gate re-operation in 2018 and meet water quality standards.

Session 24. CalSim and CalLite Model Applications

1. Reclamation Updates to CalSim-II

Presenter(s): Nancy Parker (U.S. Bureau of Reclamation)
Presenter(s) Email Address(es): nparker@usbr.gov

Collaborators: David O'Connor, James Gilbert, Amanda Becker
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Reclamation has developed several updates to the CalSim II model, including Settlement Contractor demands, Wilkins Slough flows, reservoir balancing, negative carriage water operations, and export estimates. Studies have been constructed to reflect recent historical operations as well as full regulatory obligations. Development of refined criteria and study results will be presented.

2. San Joaquin Hydrology and the Fully-Connected Sacramento-San Joaquin CalSim 3.0 Model
Presenter(s): James Gilbert (US Bureau of Reclamation)
Presenter(s) Email Address(es): jmgilbert@usbr.gov
Collaborators: Dave O'Connor, Jim Shannon, Nancy Parker (U.S. Bureau of Reclamation), Andy Draper (Stantec)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Bureau of Reclamation has continued development of the San Joaquin basin in CalSim 3.0. The current implementation resolves hydrology issues and improves simulation of operations in the basin. Specific issues addressed include high groundwater, biased stream-groundwater fluxes, and applied water demands adjustments. The fully connected Sacramento/San Joaquin CalSim 3.0 model has been made available for review, and Reclamation and DWR are engaged in seeking specific feedback on improving hydrologic consistency at the demand unit scale and consistency of operational and Delta dynamics at the system scale.

3. CalSim and Tableau: Decision Support Through Visual Analytics
Presenter(s): Karandev Singh and Nur Taraky (DWR)
Presenter(s) Email Address(es): Karandev.Singh@water.ca.gov, Nur.Taraky@water.ca.gov
Collaborators: Erik Reyes, Nazrul Islam, Karandev Singh, Raymond Hoang, Nur Taraky, Chris Quan, Ali Abrishamchi (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
Staff from the Bay-Delta Office's Modeling Support Branch will present recent efforts to use Tableau, a business intelligence and visual analytics software, as a standalone post-processing tool to analyze CalSim results. Specifically, this presentation will demonstrate that Tableau can fulfill an increasing need to standardize CalSim/CalLite output data processing, handle large datasets, and produce insightful visualizations while leveraging a platform that is adaptable for new data visualization needs. In addition to streamlining data analysis, the modeling group is pursuing a parallel goal of improving data accessibility with plans to utilize Tableau's online platform and ability to connect to multiple data formats.

Session 25. Climate Change

1. Projected Changes in Runoff of California's Major Water Supply Watersheds in the 21st Century
Presenter(s): Minxue (Kevin) He, California Department of Water Resources (DWR)
Presenter(s) Email Address(es): kevin.he@water.ca.gov
Collaborators: Andrew Schwarz, Elissa Lynn, Michael Anderson (DWR)
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:

This study aims to assess potential changes in runoff of major water supply watersheds in the State under projected climate change scenarios. The study employs the latest climate model projections from the Coupled Model Inter-comparison Project Phase 5 (CMIP5). Specifically, 20 individual downscaled projections (1/16 degree, approximately 6 by 6 kilometers) on precipitation and temperature are utilized to drive the distributed Variable Infiltration Capacity (VIC) model to generate runoff simulations from 2020-2099 for four Sacramento watersheds and four San Joaquin watersheds. The 20 climate projections come from 10 Climate Circulation Models (GCMs) (selected by the Climate Change Technical Advisory Group of DWR) under two Representative Concentration Pathways (RCP 4.5 and RCP 8.5). The VIC model is calibrated against monthly full natural flow at these watersheds using historical precipitation and temperature data from 1970-2003. The results indicate that annual runoff increases on average when compared to the historical baseline (1951-1990). April-July runoff generally increases except for the scenario for late 21st century (2060-2099) under the PCR 8.5 pathway. Runoff peak timing remains largely unchanged for the San Joaquin watersheds. However, for Sacramento watersheds peak timing tends to shift earlier. During the period from 2020-2099, there is no significant trend in the annual runoff.

2. Ensemble Flow Forecasts for Risk Based Reservoir Operations of Lake Mendocino: An Adaptive Approach to Reservoir Management

Presenter(s): Chris Delaney (Sonoma County Water Agency)
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Collaborators: John Mendoza (Sonoma County Water Agency), Brett Whitin (California Nevada River Forecast Center), Robert Hartman (Consultant), Jay Jaspers (Sonoma County Water Agency)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

Forecast informed reservoir operations (FIRO) is a methodology that incorporates short to mid-range precipitation and flow forecasts to inform the flood operations of reservoirs. The Ensemble Forecast Operations (EFO) alternative is a probabilistic approach of FIRO that incorporates ensemble streamflow predictions (ESPs) made by NOAA's California-Nevada River Forecast Center (CNRFC). With the EFO approach, release decisions are made to manage forecasted risk of reaching critical operational thresholds. A water management model was developed for Lake Mendocino, a 111,000 acre-foot reservoir located near Ukiah, California, to evaluate the viability of the EFO alternative to improve water supply reliability but not increase downstream flood risk. Lake Mendocino is a dual use reservoir, which is owned and operated for flood control by the United States Army Corps of Engineers and is operated for water supply by the Sonoma County Water Agency. Due to recent changes in the operations of an upstream hydroelectric facility, this reservoir has suffered from water supply reliability issues since 2007. The EFO alternative was simulated using a 26-year (1985-2010) ESP hindcast generated by the CNRFC. Model simulation results demonstrate that the EFO alternative may improve water supply reliability for Lake Mendocino yet not increase flood risk for downstream areas. The developed decision support system provides a potential reservoir operations alternative to adaptively manage changes in extreme weather predicted with climate change.

3. The Governance Gap: Climate Adaptation and Sea Level Rise in the San Francisco Bay Area

Presenter(s): Mark Lubell (UC Davis)
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Permission to Post pdf of Presentation on CWEMF Website: yes
Abstract: not available

4. The Role of Modeling in California's Fourth Climate Change Assessment
Presenter(s): Jamie Anderson, California Department of Water Resources (DWR)
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Abstract:
California is a national and world leader in integrating climate change science in the planning and decision making process. California's Fourth Climate Change Assessment, which will be released in summer of 2018, will be informed by 32 funded research projects and nearly a dozen external collaborations. This talk will highlight some of the data and modeling used or developed during this Assessment.

Session 26. SGMA

1. SGMA Technical Assistance and Climate Change Guidance
Presenter(s): Steven Springhorn and Tyler Hatch (California Department of Water Resources)
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Abstract:
The Sustainable Groundwater Management Program (SGMP) at the Department of Water Resources (DWR) is providing technical assistance to Groundwater Sustainability Agencies (GSAs) for their Groundwater Sustainability Plan (GSP) development. In addition to DWR's Data, Tools, and Reports webpage, a number of new resources have recently become available through our SGMA Data Viewer. The SGMA Data Viewer allows GSAs and the public to easily access groundwater and GSP related datasets and includes a variety of tools that will allow users to download and analyze these datasets for GSP development.

One such dataset is climate change data. The SGMP recommends the use of the climate change data initially developed under the Prop 1 Water Storage Investment Program (WSIP) and has taken additional steps to improve the user friendliness of the information for use in developing projected water budgets. The accompanying guidance document includes additional recommendations for the use and assumptions incorporated into the dataset. In addition, tools have been developed to facilitate the use of the data into integrated hydrologic modeling platforms (IWFM and MODFLOW-OWHM).

2. Groundwater Models as a Tool to Support Sustainable Groundwater Management in a Basin with Strong River-Aquifer Interactions
Presenter(s): Laura Foglia
Presenter(s) Email Address(es): lfoglia@ucdavis.edu
Collaborators: Douglas Tolley, Thomas Harter
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The Sustainable Groundwater Management Act (2014) seeks to maintain groundwater discharge to streams through sustainable evaluation of groundwater pumping and through groundwater management. Some measurements can be collected in the field to evaluate such

groundwater/surface- water interactions, but models are needed to fully understand current groundwater flow dynamics, and to assess potentially beneficial impacts to streamflow under future management scenarios. Water budget models provide insight into regional groundwater/surface water interactions. But integrated groundwater/surface- water computer models are most useful to fully assess and understand groundwater/surface water dynamics. Here we use the Scott Valley, groundwater basin to show that detailed water budget provides important data on irrigation, evapotranspiration, pumping, recharge, and net groundwater flows to the stream system. Water budget results are integrated into a computer model that accounts for groundwater flow, streamflow, and landscape water fluxes. Different conceptual representations of the stream-aquifer boundary provide significantly different results in the seasonal dynamics groundwater/surface water fluxes. This underscores the importance of choosing and testing the tools to simulate the various boundary conditions driving groundwater dynamics and groundwater/surface water interactions.

3. GSP Development from the Butte County Perspective

Presenter(s): Christina Buck, Assistant Director, Butte County Water and Resource Conservation
Presenter(s) Email Address(es): cbuck@buttecounty.net
Collaborators: Paul Gosselin, Director, Butte County Water and Resource Conservation
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Abstract:

Butte County has actively managed and protected water resources for the past several decades through county Ordinances, data development and modeling, and monitoring. Developing a Groundwater Sustainability Plan under SGMA presents a new challenge, but also an opportunity to continue to expand our understanding of the groundwater resource and aquifer characteristics to support the economy, communities and environment in the County through effective groundwater management. The presentation will describe how development of the GSP will build on existing projects and programs, develop new understanding of the aquifer structure using geophysics, and continue modeling efforts. In addition, the County got a jump start on potential projects and actions to achieve sustainability by evaluating recharge opportunities through a project funded by the Prop 1 Counties with Stressed Basins Grant. All of this is in the context of multiple GSAs establishing governance in the four subbasins within Butte County: Vina, East Butte, West Butte, and Wyandotte Creek. It's definitely messy, but the potential is great for more science, increased understanding, and effective local groundwater management.

4. Groundwater Quantity and Quality Model Developed as a Salt and Nitrate Management Analysis Tool for a Management Zone in California's Eastern Kings Subbasin

Presenter(s): Mohamed Nassar (Luhdorff & Scalmanini, Consulting Engineers)
Presenter(s) Email Address(es): mnassar@lsce.com
Collaborators: Vicki Kretsinger Grabert (Luhdorff & Scalmanini, Consulting Engineers), Barbara Dalgish (Luhdorff & Scalmanini, Consulting Engineers), John Dickey (PlanTierra), Danielle Moss (Larry Walker Associates)
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:

For the purposes of Salt and Nitrate Management Plans (SNMP), management zones (MZ) are created that cover a spatial area within which salt and nitrate can be managed by one or more entities. As an archetype for the Central Valley SNMP, an MZ was defined for Alta Irrigation District (AID), located in the eastern portion of the Kings Subbasin. Management conditions were developed to represent ongoing shifts in land and water management. Loading of surface recharge (mass and volume) allows

the assessment of the effects of various management regimes on groundwater quality (e.g., changes in irrigation efficiency and fertilization rates, artificial recharge projects, improving POTW effluent quality, etc.). Four different scenarios were developed to study the effect of each management condition.

A groundwater flow and transport model was developed using MODFLOW and MT3DMS to investigate the effects of different management practices on underlying groundwater over time. A local AID model was developed by extracting a portion of the Kings Subbasin from the USGS's large-scale Central Valley Hydrologic Model (CVHM) (Faunt et al., 2009) with several modifications and refinements. The transport modeling was run forward in time for 100 years to assess the effects of surface loading changes on different zones in the saturated subsurface. As a result of both groundwater quantity and quality concerns needing to be considered under the Sustainable Groundwater Management Act (SGMA), there are opportunities to coordinate groundwater flow and transport modeling approaches to address both objectives.

Session 27. Conjunctive Use Modeling and One-Water (MODFLOW-OWHM) – Examples, Applications and Companion Simulators

1. Introduction to Session and One-Water Overview

Presenters: Scott E. Boyce, PhD (USGS)
Presenters Email Addresses: seboyce@usgs.gov
Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
The One-Water Hydrologic Flow Model (One-Water) is a MODFLOW-based integrated hydrologic flow model designed for the analysis of a broad range of conjunctive-use and sustainability issues. It was motivated by the need to merge the multiple variants of MODFLOW-2005 to yield an enhanced unified version capable of simulating conjunctive use and management, sustainability, climate-related issues, and managing the relationships between groundwater, surface water, and land usage. The first version, released in 2014, was selected by The World Bank Water Resource Software Review in 2016 as one of three recommended simulation programs for conjunctive use and management modeling. This presentation will introduce the session and well as point out key new features to the One-Water framework.

2. Salinity Demand and Reservoir Operations in the Second Version of One Water Hydrologic Flow Model

Presenter(s): Randall T. Hanson (One-Water Hydrologic)
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Collaborators:
Permission to Post pdf of Presentation on CWEMF Website: Yes
Abstract:
While the second version of the One Water Flow Model has many new features, two that could be significant to SGMA are the ability to simulate additional irrigation demand for salinity leaching and a reservoir operations linkage. Like some other ancillary demands, the ability to simulate salinity demands is not explicitly covered by SGMA, but could indirectly lead to additional irrigation with related groundwater-level and storage declines, and additional water-quality degradation. The

demand for additional irrigation to facilitate salt leaching is based on the concentrations of the mixture of the various source waters, the salt tolerances of the crops, and the uniformity of irrigation with depth in the soil zone. The potential increase in irrigation ranges from 22 to 38 percent for the One-Water example, with vegetable row crops showing larger leaching requirements.

The demand-driven linkage to reservoirs with the Surface-Water Operations (SWO) provides an internal tight coupling of reservoir operations within the supply-and-demand framework and related feedbacks of One Water needed for conjunctive-use analysis. SWO alters the amount of water available for irrigation, the timing and magnitude of groundwater-level and storage declines, and related land subsidence. Regulated flows provide more water for irrigation and potential for more crops to be grown. SWO shifts the supply source to surface waters in the early months of irrigation similar to Central Valley water use. The SWO process allows the user to develop multiple rule sets and keep track of allotments, carry over, allocations, charges, credits, deliveries, and delivery efficiencies at multiple levels.

3. Using a Pesticide Database to Estimate Multi-Cropped Land Use

Presenter(s): Wes Henson (USGS)
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Collaborators: Matt Baillie, DJ Martin
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Abstract:

Better land-use data results in improved integrated hydrologic models that are needed to look at the feedback between land and water use, specifically for adequately representing changes and dynamics in rainfall-runoff, urban and agricultural water demands, and surface fluxes of water. Currently, land-use data typically are compiled from annual (e.g., Crop Scape) or multi-year composites if mapped at all. While this approach provides information about interannual land-use practices, it does not capture (1) dynamic land-use changes from high frequency multi-crop rotations and (2) uncertainty in sub-annual crop distribution, planting times, and cropped areas. California has collected spatially distributed data for agricultural pesticide use since 1974 through the California Pesticide Information Portal (CalPIP). A method leveraging the CalPIP database has been developed to provide vital information about dynamic agricultural land use (e.g., crop distribution and planting times) and water demand issues in Salinas Valley, California, along the central coast. Results of this method show good correspondence with county agricultural production reports through time for all of the major crops in the basin. This presentation will illustrate the improved estimates of agricultural demands using this new method relative to assuming static multi-year land use. This new tool provides a way to provide more dynamic crop data in hydrologic models. While the current application focuses on the Salinas Valley, the methods are extensible to all of California and other states with similar pesticide reporting. The improvements in representing variability in crop patterns and associated water demands increase our understanding of land-use change and precision of hydrologic decision models.

4. Using the Basin Characterization Model to Develop Hydrologic Boundary Conditions for One Water Hydrologic Models

Presenter(s): Dina Saleh (USGS)
Presenter(s) Email Address(es): dsaleh@usgs.gov
Collaborators: Lorrie Flint, Michelle Stern
Permission to Post pdf of Presentation on CWEMF Website: No
Abstract:

The Basin Characterization Model (BCM) is a monthly regional water-balance model that can provide process-based estimates of recharge and runoff for ungaged locations. The water balance calculations are performed at different time steps (daily, monthly, and annual) at a 270 square meters (m2) grid cell spacing. BCM inputs include precipitation, air temperature, potential evapotranspiration, topography, soil properties, geology, and vegetation type. The BCM is calibrated by adjusting bedrock permeability and vegetation evapotranspiration to match outputs of simulated runoff to local streamflow. Once calibrated, BCM outputs of recharge and runoff can be generated. Fine-scale climate and PET inputs can be applied to MODFLOW-One Water Hydrologic Flow Model (One-Water) grid cells. Historical monthly runoff can then be applied as the inflow to the streamflow network that is simulated by One-Water, and recharge can be applied as subsurface boundary conditions. If necessary results of the BCM model can be scaled to help One-Water model calibration, but still preserve the spatial distribution of recharge and runoff inputs as well as the long term timing of climate impacts on the hydrologic boundary conditions. Future climate projections can also be used by the BCM to simulate potential future recharge and runoff conditions for One-Water models.

5. An Update to the Central Valley Hydrologic Model – A Regional Tool to Evaluate Sustainable Groundwater Management

Presenters: Claudia Faunt (USGS)
Presenters Email Addresses: ccfaunt@usgs.gov
Collaborators: Jon Traum (USGS) and Michelle Sneed (USGS)
Permission to Post pdf of Presentation on CWEMF Website: No

Abstract:
The Central Valley covers about 20,000 mi^2 and is one of the most productive agricultural regions in the world. Because the valley is semi-arid, surface-water availability varies substantially. Agricultural demand for irrigation is heavily reliant on surface water and groundwater. Starting in the 1950s, state and federal water distribution systems have eased the reliance on groundwater as dependence shifted to diverted surface water. In the last 20 years, however, land-use changes and limitations to surface-water availability—including drought, pumping restrictions and increased environmental flow requirements —have resulted in increased groundwater pumping, causing groundwater-level and groundwater-storage declines, subsidence, decreased stream flows, and changes to ecosystems. The spatially variable subsidence has changed the land-surface slope in some places and caused changes to drainage and damage to infrastructure, including surface-water delivery canals. As land use and surface-water availability continue to vary, long-term groundwater-level and subsidence monitoring, analysis, and modeling are critical to understanding the dynamics of historical and continued groundwater use resulting in groundwater-storage changes and associated subsidence. Regional modeling tools, such as the USGS Central Valley Hydrologic Model, can be used in the evaluation of management strategies to mitigate adverse impacts due to subsidence while also optimizing water availability. This knowledge will be critical for successful implementation of sustainable groundwater management.

Recommended Additions to the Existing Bylaws

Section 4.13 Membership Candidates. Any individual or legal entity, private or governmental, interested in promoting the purposes of the Forum may become a member of the Forum in accordance with these Bylaws. The Forum does not restrict membership in accordance with the California Code of Regulations at *2 CCR §11006*.

Section 4.14 Termination or Suspension of Membership. Membership with the Forum may be terminated or suspended if the Individual or Organization Member (Member) fails to pay dues, fees, or assessments by the date they become payable or if the conduct by a Member is seriously detrimental to the purposes and goals of the Forum or in violation of the rules and documented procedures of the Forum, including but not limited to a violation of these Bylaws. The loss of membership rights and the procedure for revocation and reinstatement of membership are defined in Sections 4.14(a) through 4.14(d).

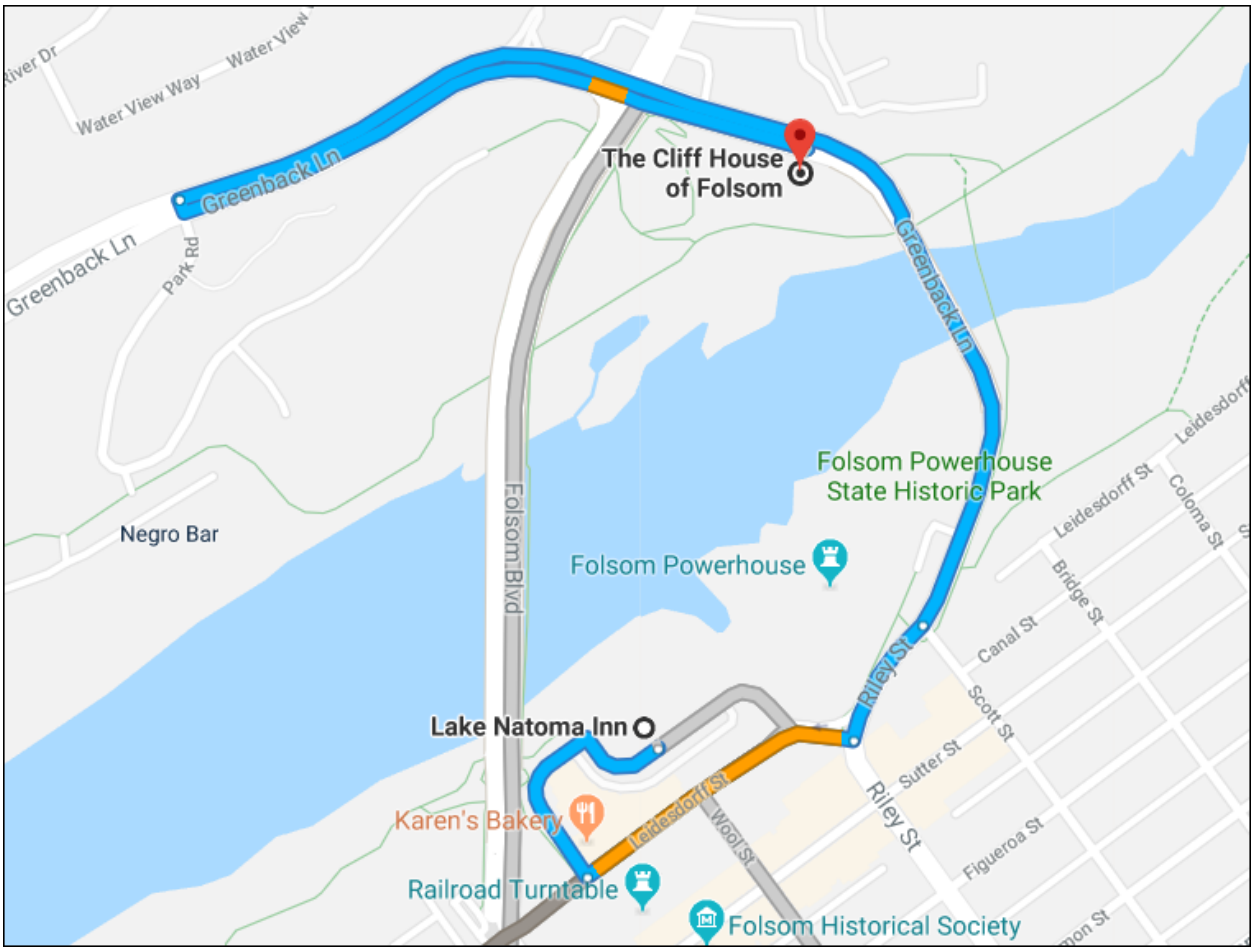
(a) Loss of Membership Rights. A suspended Member shall not be considered a Member in good standing during the period of suspension, and shall take no part in any of the activities, funds, rights, and interests belonging to the Forum until such time as such Member complies with the requirements for the removal of the suspension and the return to good standing.

(b) Procedure for Revocation and Reinstatement of Membership if Dues, Fees, or Assessments are Unpaid. Membership, and all associated privileges and rights, are automatically terminated if a Member is no longer in good standing. All privileges and rights are restored when all dues, fees, or assessments are paid in full.

(c) Procedure for Suspension or Revocation of Membership for Detrimental Actions or Violations of Rules. If the conduct by a Member is seriously detrimental to the purposes and goals of the Forum or in violation of the rules and documented procedures of the Forum, the Steering Committee may initiate proceedings for suspension or termination of membership by adopting a resolution of intention to take such action against the affected Member. The resolution must be adopted according to the requirements of Section 6.03 and Section 6.04. A written notice shall be given to the affected Member stating the action proposed to be taken by the Steering Committee (i.e., termination or suspension of membership) and the facts and circumstances relied upon by the Steering Committee as the justification for such intended action. The notice shall also specify the date on which the Steering Committee proposes to take such action, which shall be more than thirty (30) days from the date of the notice. The notice shall further advise the affected Member that the Member is entitled to an opportunity to be heard, either orally or in writing, prior to the date of the intended action. Upon request by the Member, the Steering Committee shall schedule a meeting for the purpose of hearing any evidence the Member desires to present to the Steering Committee in person or through a representative selected by the Member. The decision by the Steering Committee concerning suspension or revocation of membership shall be final and binding.

(d) Reinstatement of Membership After Revocation. A Member whose membership has been revoked shall be eligible to rejoin the Forum by submitting a petition to the Steering Committee. Such petition must be approved according to the requirements of Section 6.03 and Section 6.04. A former Member shall not be considered for readmission until all arrears in dues and/or other monetary obligations to the Forum, including assessment of reasonable costs related to the loss and restoration of membership, shall have been paid.

DIRECTIONS TO BUSINESS MEETING
(CLIFF HOUSE OF FOLSOM)



DIRECTIONS:

- Depart Lake Natoma Inn
- Head southwest on Gold Lake Dr toward Leidesdorff St for 0.2 mi
- Turn left onto Leidesdorff St, travel 0.2 mi
- Turn left onto Riley St, travel 450 ft
- Continue onto Greenback Ln, travel 0.8 mi
- Make a U-turn at Park Rd, travel 0.4 mi
- Destination will be on the right:
  The Cliff House of Folsom, 9900 Greenback Ln, Folsom, CA 95630

LIST OF LOCAL RESTAURANTS

1. Sutter Street Grill – 811 Sutter St
2. Marly and Moo – 608 Sutter St
3. Heckle Alehouse & Eatery – 705 Gold Lake Dr #390
4. Q'Bole! Mexican Cocina & Cantina – 718 Sutter St
5. Chicago Fire - 614 Sutter St
6. Hacienda Del Rio Mexican Restaurant – 702 Sutter St
7. Hop Sing Palace – 805 Sutter St
8. Pizzeria Classico – 702 Sutter St
9. Samuel Horne's Tavern – 719 Sutter St
10. Folsom Hotel – 703 Sutter St
11. Sutter Street Taqueria – 727 Sutter St
12. Pure Life Juice Co. 604 Sutter St #190
13. Cliff House – 9900 Greenback Lane

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