California Water and Environmental Modeling Forum

2025 ANNUAL MEETING PROGRAM

AM XXXI

Navigating the Currents: Collaborating to Overcome Challenges in California Water

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

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OFFICERS

Jesse Jankowski, Convener

Vivek Bedekar, Vice Convener

Stacy Tanaka, Treasurer

Ben Bray, Secretary

Tariq Kadir, Past Convener

Paul Hutton, Executive Director

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KEYNOTE ADDRESS

Peter Goodwin, Ph.D., F. ASCE, F. ICE

Peter Goodwin started his career as a graduate research assistant to Hugo B. Fischer working on the Fischer Delta Model in 1981. He was the first Technical Director of Philip Williams and Associates before founding the Center for Ecohydraulics Research at the University of Idaho. He retired as President of the University of Maryland Center for Environmental Science (www.umces.edu) in 2024. He has served as Lead Scientist for the Science Program of the Delta Stewardship Council and as the President of IAHR – the oldest international association for water research (www.iahr.org).

SUMMARY OF SESSIONS

Monday, May 12

Time	Session	Moderator	Room
8:00 – 8:30	Registration		Sierra Hallway
8:30 – 10:15	1. CalSim 3 Updates and Applications	Jonathan Byers	Sierra 1
	2. The Impact of Groundwater Pumping on Interconnected Surface Water: Technical Approaches and SGMA Compliance	Vivek Bedekar & Ali Taghavi	Sierra 2
	3. Connecting Data with Users: Open Water and Ecological Data and Tools	Christina McCready	Sutter
10:15 - 10:30	Break		
10:30 - 12:15	4. Updates on the Representation of Groundwater in CalSim	Can Dogrul	Sierra 1
	5. California Water Plan: The Future is You	Paul Shipman	Sierra 2
	6. Accounting for System Flows, Consumptive Use, and Water Availability in the Sacramento-San Joaquin Delta Basin	Will Anderson	Sutter
12:15 – 1:00	Lunch - Included in registration fee		
1:00 – 2:00	7. CWEMF Awards Ceremony	Tariq Kadir	Sierra 1
2:00 – 2:05	Break		
2:05 – 3:15	8. Pop-up Talks	Stacy Tanaka	Sierra 1
3:15 – 3:30	Break		
3:30 – 5:15	9. DSM2 Improvements	Xiaochun Wang	Sierra 1
	10. Advances in Aquifer Recharge Modeling	Menberu Meles	Sierra 2
	11. Recent applications of sediment transport modeling for California dam removals	Adam Witt	Sutter
5:30 - 8:00	12. Business Meeting and Social	Vivek Bedekar	Folsom Community Center: Rotary Clubhouse

SUMMARY OF SESSIONS

Tuesday, May 13

Time	Session	Moderator	Room
7:30 - 8:00	Registration		Sierra Hallway
8:00 - 9:45	13. Themes in CalSim Development	Zachary Roy	Sierra 1
	14. Update on DWR's Basin Characterization Program	Mesut Cayar	Sierra 2
	15. Atmospheric Rivers and Water Resources in California: Challenges and Opportunities	Luciana Kindl Da Cunha	Sutter
9:45 - 10:00	Break		
10:00 - 11:45	16. Machine Learning for Water & environmental modeling	Kevin He	Sierra 1
	17. Modeling of CalSim 3 Inputs	Mohammad Hasan	Sierra 2
	18. Integrating Forecast-Informed Strategies and Multi-Benefit Approaches for Sustainable Flood-MAR Operations	Ali Taghavi	Sutter
11:45 - 12:30	Lunch - Included in registration fee		
12:30 - 1:10	19. Keynote Address – Peter Goodwin	Vivek Bedekar	Sierra 1
1:10 - 1:15	Break		
1:15 – 3:00	20. Modeling Tools & Frameworks for a Potential New Era of Flow & Temperature Management on the Trinity River	Adam Witt	Sierra 1
	21. Poster Session*	---	Sierra 2
	22. Updates to DWR's C2VSim Fine Grid Model	Craig Altare	Sutter
3:00 - 3:15	Break		
3:15 - 5:00	23. Implementation of the Sites Project in CalSim 3	Reed Thayer	Sierra 1
	24. Poster Session*	---	Sierra 2
	25. Reducing Climate Change Uncertainty for Regional Water Resources Management	Yuchuan Lai	Sutter
5:00 - 7:00	26. Poster Session * & Social	Stacy Tanaka	Sierra 1

* Posters will be set up and available for viewing mid-afternoon. Presenters will be available from 5:00 to 7:00 pm.

SUMMARY OF SESSIONS

Wednesday, May 14

Time	Session	Moderator	Room
7:30 - 8:00	Registration		Sierra Hallway
8:00 - 9:45	27. Advancing Sustainable Water Management Through Flood Managed Aquifer Recharge: Insights from the San Joaquin Flood-MAR Watershed Studies	Francisco Flores-Lopez	Sierra 1
	28. Applied Modeling for Effective Decision Support	Tyler Hatch	Folsom/Natoma
9:45 - 10:00	Break		
10:00 - 11:45	29. Science in a Changing Climate	Steve Andrews	Sierra 1
	30. Managing Land Subsidence: Applied Modeling and Subsidence Best Management Practices (BMP)	John Ellis & Jeremy White	Folsom/Natoma
11:45 - 1:15	Lunch at area restaurants		
1:15 - 3:00	31. Planning from the bottom-up: Modelling CVP and SWP operations at a daily timestep	Harrison Zeff	Sierra 1
	32. The Why, How, and What of Decision Scaling: How to Make Risk Informed Decisions in an Uncertain Future	Alejandro Perez & Paul Shipman	Folsom/Natoma
3:00 - 3:15	Break		
3:15 – 5:00	33. Hydrology and Climate Change	James Polsinelli	Sierra 1
	34. The COEQWAL Project: Exploring Dimensions of Equity in California's Water Resources Systems	James Gilbert	Folsom/Natoma

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MONDAY EVENING SOCIAL

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2025 ANNUAL MEETING SPONSORS (CONT'D)

TUESDAY EVENING SOCIAL

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REFRESHMENTS

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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 • cwemf@cwemf.org • www.cwemf.org

Dear CWEMF Members and Friends,

Welcome to the 31st Annual Meeting of the California Water and Environmental Modeling Forum. We're lucky to see you for the second time in the last year and grateful you're joining us back on our usual early summer meeting schedule. We hope these three days at Lake Natoma are again filled with engaging discussions and a renewed commitment to collaboration. For some of my colleagues and friends in the profession this is the only time each year that I have a chance to see you in-person and connect, so I treasure these opportunities to be together.

As ever, this year's program is full of interesting sessions covering critical and emerging topics within our field, from open data and machine learning to climate change, water accounting, and flood management. On Monday I encourage you to attend the Awards Ceremony over lunch and the evening Business Meeting and social at a new location here in the Folsom Historic District. On Tuesday we are excited to welcome Dr. Peter Goodwin as our keynote speaker, an internationally recognized expert in ecohydraulics, sediment transport, and wetland and estuarine systems. Given his extensive experience with interdisciplinary research in the Sacramento-San Joaquin Delta, I am excited for the insights he can offer us. I also encourage you to stay for the evening poster session and social to continue the great conversations of the week.

Our theme this year is "Navigating the Currents: Collaborating to Overcome Challenges in California Water." We are well-versed in adapting our models to change, be it catastrophic droughts or floods, advancing technology, or changing regulations. Today many of us may find our work impacted by unprecedented shifts in policy, uncertain funding, or other forms of non-stationary. But as a whitewater rafter (or choose your own particle in a hydraulic system) must accommodate turbulent flows, pressure changes, and the impacts of human systems, we too will weather the obstacles ahead of us with the help of those around us. I hope your time here reveals the many opportunities for mixing between the professional water bodies that each of us inhabit.

This also marks the final Annual Meeting of my term as the Forum's Convener, so please welcome the incoming officers following our Business Meeting. I am very grateful to have served such a unique and special organization which means much to my career. Thank you to our Executive Director and my fellow officers for making it an exciting and enjoyable journey. I look forward to staying on the Steering Committee and encourage any of you to reach out and learn more about how to get involved in our organization's inner workings. CWEMF is preparing to execute a new Strategic Plan to ensure our future actions are aligned with our Mission Statement, and I look forward to the great things we will continue to do to help advance the water and environmental modeling profession. Thank you all for being here, and I hope you enjoy the Meeting.

Sincerely,

Jesse Jankowski, MS, PE
CWEMF Convener

CONTENTS

AGENDA

Monday, May 12

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

Refreshments sponsored by Jacobs

8:30 – 10:15 a.m.

Session 1. CalSim 3 Updates and Applications

Moderator: Jonathan Byers (DWR)
Location: Sierra 1

1. 2025 Delivery Capability Report Updates – Jamel Lehyan (DWR)
2. CalSim 3 Historical Operations – Nicole Osorio (DWR)
3. DCR Subsidence Addendum – Zachary Roy (DWR)
4. Improvements to CVP Operations and Allocation – Walter Bourez (MBK Engineers)

Session 2. The Impact of Groundwater Pumping on Interconnected Surface Water: Technical Approaches and SGMA Compliance

Moderator: Vivek Bedekar (SSP&A) & Ali Taghavi (Woodard & Curran)
Location: Sierra 2

1. DWR's Interconnected Surface Water Depletion Guidance and Technical Papers – Craig Altare (DWR)
2. Best Available Science: Navigating Data Limitations Associated with Depletions – Sercan Ceyhan (Woodard & Curran)
3. Application and Comparison of Methods and Interfaces for Estimating Stream Depletion to Develop Management Alternatives in the Intermountain West – Gilbert Barth & Matthew Tonkin (S.S. Papadopulos & Associates)
4. Conceptual Uncertainties in Modeling Depletion of Interconnected Surface Water - Tyler Hatch (INTERA)

Session 3. Connecting Data with Users: Open Water and Ecological Data and Tools

Moderator: Christina McCready (DWR)
Location: Sutter

1. Introduction on Open and Transparent Water Data Publication at DWR – Mitch Russo & Mahesh Gautum (DWR)

2. Open Data and Tools Available from the Water Boards – Rafael Maestu (SWRCB)

3. Overview and Advanced Features of the CNRA Open Data Platform – David Harris (DWR)

4. Open Data Availability: How to Access Data Efficiently Using CKAN API – Aaron Cuthbertson (DWR)

5. Interactive Dialog: Improving the Usability of Data and Data Portals – Robyn Grimm (California Water Data Consortium)

10:30 a.m. – 12:15 p.m.

Session 4. Updates on the Representation of Groundwater in CalSim

Moderator: Can Dogrul (DWR)
Location: Sierra 1

1. Calibration of the California Central Valley Groundwater-Surface Water Simulation Model – Coarse Grid (C2VSim-CG) – Steven Jepsen (DWR)

2. C2VSimCG and CalSim 3 Alignment updates – Malinda Wimalaratne (DWR)

3. Automated Calibration Workflow for the GW-DLL – Sercan Ceyhan & Ali Taghavi (Woodard & Curran)

4. Aligning C2VSimCG and CalSim Applications for Future Modeling Needs – Can Dogrul (DWR)

Session 5. California Water Plan: The Future is You

Moderator: Paul Shipman (DWR)
Location: Sierra 2

1. California Water Plan Update 2023 – Roadmap to Resilience and benefits of being involved in Water Plan – Lew Moeller (DWR)

2. Menu of Water Plan Activities – Eric Tsai, Megan Fidell, Lucian Filler, Jennifer Stricklin, Paul Shipman (DWR)

3. Interactive dialog with session attendees on concepts of Water Plan Update 2028 – Paul Massera (DWR)

Session 6. Accounting for System Flows, Consumptive Use, and Water Availability in the Sacramento-San Joaquin Delta Basin

Moderator: Will Anderson (SWRCB)
Location: Sutter

1. Parsing Flows in the Sacramento-San Joaquin Watershed: What We Don't Know, But Need to Know – Greg Gartrell (Public Policy Institute of California)

2. Water Rights Reporting & Measurement, the Delta Alternative Compliance Plan, and Support for a New Delta Water Balance – Will Anderson (SWRCB)

3. Accounting Framework for Implementing the Proposed Agreements for Healthy Rivers and Landscapes – TBD (DWR)

4. Actions and Accounting to Make Water Available – Lee Bergfeld & Wesley Walker (MBK Engineers)

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 Jacobs & Pacific Agroecology

1:00 – 2:00 p.m.

Session 7. CWEMF Awards Ceremony

Moderator: Tariq Kadir (CWEMF Past Convener)
Location: Sierra 1

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

2:05 – 3:15 p.m.

Session 8. Pop-up Talks

Moderators: Stacy Tanaka (Watercourse Engineering)
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 9. DSM2 Improvements

Moderator: Xiaochun Wang (DWR)
Location: Sierra 1

1. Update: DSM2 Cross-Section Development Program (CSDP) – Bradley Tom (DWR)

2. Inferring unknown salinity loads using a response-based inverse modeling method – Zhenlin Zhang (DWR)

3. Integrating Cloud Computing Capability to ECO-PTM Simulations – Xiaochun Wang (DWR)

4. Clifton Court Forebay: gate characterization and operational effect study – Sophie Munger (DWR)

5. New EC-based Operating Rule in DSM2 – Yujia Cai (DWR)

Session 10. Advances in Aquifer Recharge Modeling

Moderators: Menberu Meles (USDA)
Location: Sierra 2

1. TBD Sensitivity Analysis of Groundwater Recharge to Soil Properties in the Central Valley – Jiao Wang (UC Davis)

2. Optimizing Managed Aquifer Recharge (MAR) Applications at a Hillslope Scale in California's Central Valley – Xinying Ling (UC Riverside)

3. Spatio-Temporal Modeling of Groundwater Flow Dynamics Under Extensive Irrigation in the San Joaquin Valley – Tibebe Tigabu (UC Riverside)

4. An Externally Coupled Multi-Model Framework for Integrated Surface-Subsurface Flow and Solute Transport on Hillslopes – Sakiur Rahman (UC Riverside)

5. Drivers of Soil Moisture Dynamics over Continental United States – Mashrekur Rahman (UC Davis)

Session 11. Recent applications of sediment transport modeling for California dam removals

Moderator: Adam Witt (Stantec)
Location: Sutter

1. Dam Removal below a New Reservoir: Modeling Sediment Management Scenarios for the Pacheco Reservoir Expansion Project – Adam Witt (Stantec)

2. Dam to Estuary: Simulating Sediment Fate Following Dam Removal – Chris Lyle (Stillwater Sciences)

3. Klamath River Sediment Loads During and Following Dam Removal – Scott Wright (CBEC)

4. Making Change less Scary: Predicted and Observed Response from Klamath Dam Removals – Blair Greimann (Stantec)

5:30 – 8:00 p.m.

Session 12. Business Meeting and Social

Moderator: Vivek Bedekar (CWEMF/S.S. Papadopulos & Associates)
Location: Folsom Community Center, Rotary Clubhouse

Social sponsored by MBK Engineers, Resource Management Associates, S.S. Papadopulos & Associates, and Tetra Tech Inc.

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AGENDA

Tuesday, May 13

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

8:00 – 9:45 a.m.

Session 13. Themes in CalSim Development

Moderator: Zachary Roy (DWR)
Location: Sierra 1

1. Artificial Neural Networks in CalSim – Malinda Wimalaratne (DWR)
2. The Solvers of CalSim – Hamed Zamanisabzi (DWR)
3. Plans for the Future of WRIMS – Yiwei Cheng (DWR)
4. CalSim Results Processing & Communication – Raymond Hoang (DWR)

Session 14. Update on DWR's Basin Characterization Program

Moderator: Mesut Cayar (Woodard & Curran)
Location: Sierra 2

1. An Update on DWR's Basin Characterization Program – Katherine Dlubac (DWR), Steven Springhorn (DWR)
2. Transforming resistivity data to lithology for airborne electromagnetic (AEM) surveys – Javier Peralta (Ramboll)
3. Advancing Hydrostratigraphic Model (HSM) and Groundwater Numerical Model Development with AEM and Hydrogeologic Data – Vivek Bedekar (SSP&A) & Sercan Ceyhan (Woodard & Curran)
4. Aquifer Recharge Potential Analyses: Development and Application – Mesut Cayar (Woodard & Curran)

Session 15. Atmospheric Rivers and Water Resources in California: Challenges and Opportunities

Moderator: Luciana Kindl Da Cunha (WEST)
Location: Sutter

1. Atmospheric River role for California Water Resources – Mike Dettinger (CW3E)

2. Future Changes in Atmospheric River Sequences over California – Christopher Castellano (UCSD)

3. The Limits of the Deluge: How Extreme Can Atmospheric Rivers Get? – Matthew Koszuta (WEST)

4. Enhanced Water Management through Forecast Informed Reservoir Operations (FIRO) – Ben Tustison (MBK Engineers)

5. Opportunities for California Water Resources – David Curtis (WEST)

10:00 – 11:45 a.m.

Session 16. Machine Learning for Water & Environmental Modeling

Moderator: Kevin He (DWR)
Location: Sierra 1

1. Machine Learning Protocols for Water and Environmental Modeling – Kevin He (DWR)

2. Machine Learning-Based Harmful Algal Blooms (HABs) Modeling in the Delta – Gourab Saha (DWR)

3. Emulating Traditional Statistical Models in Seasonal Streamflow Forecasting via Machine Learning – Peyman Namadi (DWR)

4. Improving Streamflow Simulation in Central Valley Watersheds Using Deep Learning – Yu-Chieh Jay Chao (UCD) and Kevin He (DWR)

5. Towards Generalization in CalSim Surrogates for Drought, Sea Level and Landscape Change – Eli Ateljevich (DWR)

Session 17. Modeling of CalSim 3 Inputs

Moderator: Mohammad Hasan (DWR)
Location: Sierra 2

1. Advancements in modeling reference evapotranspiration for CalSim3 – Mohammad Hasan (DWR) and Bridget Childs (Stantec)

2. CalSim 3 Upper San Joaquin Model – Mina Shahed Behrouz (Stantec)

3. VIC-perturbed CalSim 3 Rim Inflows for Climate Change Scenarios – Ruian Dong & Jay Wang (DWR)

4. CalSim3 historical hydrology model – Bridget Childs (Stantec) and Ryan Lucas (USBR)

Session 18. Integrating Forecast-Informed Strategies and Multi-Benefit Approaches for Sustainable Flood-MAR Operations

Moderator: Ali Taghavi (Woodard & Curran)
Location: Sutter

1. FIRO-MAR Operations with 1-to-7-day Synthetic Ensemble Forecast – Alex Vdovichenko (DWR)

2. Balancing Recharge and Ecology: Optimizing Flood-MAR Strategies for Sustainable Water Management – Taylor Spaulding (ESA)

3. Developing Multi-Benefit Flow-Through Basins for Flood Risk Reduction, Groundwater Recharge, and Habitat Enhancement – Dainiel Siegel (Earthgenome)

4. Improving Watershed-Scale Recharge: Tools, Strategies, and Multi-Sector Benefits – Dominick Amador (Woodard & Curran)

11:45 a.m. – 12:30 p.m. – Lunch

Pick up a box lunch and then join us for the keynote address in Sierra 1.

Lunch sponsored by Larry Walker Associates

12:30 – 1:10 p.m.

Session 19. Keynote Address: Dr. Peter Goodwin

Moderator: Vivek Bedekar (CWEMF/S.S. Papadopulos & Associates)
Location: Sierra 1

1:15 – 3:00 p.m.

Session 20. Modeling Tools and Frameworks for a Potential New Era of Flow and Temperature Management on the Trinity River

Moderator: Adam Witt (Stantec)
Location: Sutter

1. Boundary conditions formulation for Trinity Lake, Lewiston Lake, and Trinity River, model application and performance of the available W2 and ResSim models – Mike Deas (Watercourse Engineering)

2. Modeling analysis of Humboldt County Contract Water releases into the Trinity River – Adam Witt (Stantec)

3. A Method to Implement Natural Flow Regimes for Regulated Rivers In Constrained Management Contexts – Nicholas Som (USGS)

Session 21. Poster Session

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

Session 22. Updates to DWR's C2VSim Fine Grid Model

Moderator: Craig Altare (DWR)
Location: Sierra 1

1. Introduction to DWR's C2VSimFG Application – Purpose, Current Updates, Future Plans – Craig Altare (DWR)

2. Land Surface Process Updates to C2VSimFG – Lan Liang (DWR)

3. Surface Water Process Updates to C2VSimFG – Guobiao Huang (DWR)

4. C2VSimFG Web Application – Thi Pham (DWR) and Tom Heinzer (Michael Thomas Group)

5. Development of a Contaminant Transport Module for IWFM – Uditha Bandara (DWR)

3:15 – 5:00 p.m.

Session 23. Implementation of the Sites Project in CalSim 3

Moderator: Reed Thayer (Jacobs)
Location: Sierra 1

1. Overview of the Sites Project and Rationale for Migration to CalSim 3 – Angela Bezzone (MBK Engineers)

2. Cartography meets Modeling: Implementing a Complex Offstream Reservoir in CalSim 3 – Reed Thayer (Jacobs)

3. Estimation of Daily Flows in CalSim 3 for the Sites Project – Luke Philbert (Jacobs)

4. Simulation of Sites Reservoir Delta and Storage Exchange Operations – Tom Fitzhugh (Stantec) and Puneet Khatavkar (Stantec)

Session 24. Poster Session

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

Session 25. Reducing Climate Change Uncertainty for Regional Water Resources Management

Moderator: Yuchuan Lai (Tetra Tech)
Location: Sutter

1. Exploring the best available California climate model data for civil engineering use OR Is the best available climate model data sufficient to plan for climate adaptation? – Marie Buhl (UC Merced)

2. Advancing Climate Risk-Informed Flood Inundation Mapping: A Case Study of the Tuolumne River Watershed – Romain Maendly (DWR)

3. Uncertainties in Assessments of Climate Change impact on SWP/CVP – Jay Wang (DWR)

4. Constraining Long-term Streamflow Projections of Colorado River Basin for Improved Water Resources Management – Yuchuan Lai (Tetra Tech)

5:00 – 7:00 p.m.

Session 26. Poster Session & Social

Location: Sierra 1
Moderator: Stacy Tanaka (Watercourse Engineering)

Posters will be set up for viewing mid-afternoon. Presenters will be available from 5:00 p.m. to 7:00 p.m.

Social sponsored by ICF, Stantec, Watercourse Engineering, and Woodard & Curran

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AGENDA

Wednesday, May 14

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

8:00 – 9:45 a.m.

Session 27. Advancing Sustainable Water Management Through Flood Managed Aquifer Recharge: Insights from the San Joaquin Flood-MAR Watershed Studies

Moderator: Francisco Flores-Lopez (DWR)
Location: Sierra 1

1. Development of a Headwater-to-Groundwater Integrated Modeling Toolset – David Arrate (DWR)
2. Assessing Climate Vulnerability – Wyatt Arnold (DWR)
3. Enhancing Climate Resilience through Adaptive Flood-MAR Strategies – Karandev Singh (DWR)
4. Setting a Template for Multi-Sector Coordination – Jim Wieking (DWR)

Session 28. Applied Modeling for Effective Decision Support

Moderator: Tyler Hatch (INTERA)
Location: Folsom/Natoma

1. Optimization of a Seawater Intrusion Barrier in Sunset Gap, Orange Co., CA – Nathan Hatch (INTERA)
2. Model Emulation for Decision Support – Spencer Jordan (INTERA)
3. Developing Efficient and transparent groundwater modeling workflows to aid with decision support – Jeremy Bennett (INTERA)
4. The Adjoint State Method: Highly Scalable Sensitivity Analysis – Jeremy White (INTERA)

10:00 – 11:45 a.m.

Session 29. Science in a Changing Climate

Moderator: Steve Andrews (RMA/GEI)
Location: Sierra 1

1. The Delta Science Program's collaborative open science initiatives – Lisamarie Windham-Myers (USGS, DSP)

2. Modeling Water Security Strategies Under Changing Climate for Nevada Irrigation District – Hamideh Habibi (WEST Consultants) & Jared Emery (Western Hydrologics)

3. Restoring Watershed Function and Recharging the Local Aquifer – Ricardo Aguirre (WEST Consultants)

4. A methodology for long-term habitat suitability assessment in Coyote Valley, CA – Megan Casey (CBEC)

5. Improved Urban Drainage Modeling in HEC-RAS – Steve Andrews (RMA/GEI)

Session 30. Managing Land Subsidence: Applied Modeling and Subsidence Best Management Practices (BMP)

Moderator: John Ellis & Jeremy White (INTERA)
Location: Folsom/Natoma

1. Going Back to Go Forward: A case for using long-term data to improve land subsidence predictive tools and decision-making – Leila Saberi (INTERA)

2. Integrating Multi-Source Subsidence Data and Ensemble Calibration for 1D Subsidence Modeling and Probabilistic Scenarios – Marisa Earll (INTERA)

3. 1D vs 3D groundwater modeling to support decision making related to land subsidence in the Central Valley: appropriate simplification or do we need those extra two dimensions? – Jeremy White (INTERA)

4. DWR's Subsidence Best Management Practices and Technical Assistance – Ben Brezing (DWR)

11:45 a.m. – 1:15 p.m. - Lunch

Lunch at area restaurants

1:15 – 3:00 p.m.

Session 31. *Planning from the bottom-up: Modelling Central Valley and State Water Project operations at a daily timestep*

Moderator: Harrison Zeff (University of N. Carolina, Chapel Hill)
Location: Sierra 1

1. Development and application of a daily timestep water supply model (CALFEWS) for managing water supply-related financial risks – Dan Li (UNC Chapel Hill)

2. Using CALFEWS to forecast hydropower generation and consumption in the Central Valley Project – Yash Amonkar (UNC Chapel Hill)

3. California reservoir network optimization with daily ensemble hydrologic forecasts – Jonathan Herman (UC Davis)

4. Coupled System Operations and Water Temperature Simulation: Challenges and Opportunities for Shasta Reservoir and the Central Valley – James Gilbert (UC Santa Cruz)

Session 32. The Why, How, and What of Decision scaling: How to Make Risk Informed Decisions in an Uncertain Future

Moderator: Alejandro Perez & Paul Shipman (DWR)
Location: Folsom/Natoma

1. Why Decision Scaling: A Smarter Approach to Climate-Informed Water Management – Romain Maendly & Andrew Schwarz (DWR)

2. How To Do Decision Scaling – Wyatt Arnold, Karandev Singh & Paul Shipman (DWR)

3. What Resources and Tools for Decision Scaling Climate Risk Analysis – Alejandro Perez (DWR)

4. Interactive discussion

3:15 – 5:00 p.m.

Session 33. Hydrology and Climate Change

Moderator: James Polsinelli (DWR)
Location: Sierra 1

1. Snow Water Equivalent for Climate Change Scenarios – Mohammad Hasan (DWR)

2. State Water Project Climate Adaptation Plan 2025 – Zachary Roy (DWR)

3. CalSimHydro 2 Updates – James Polsinelli (DWR)

4. 2085 Climate Change Operational Impacts and Baseline Assumptions – Puneet Khatavkar (Stantec)

Session 34. The COEQWAL Project: Exploring Dimensions of Equity in California's Water Resources Systems

Moderator: James Gilbert (NOAA)
Location: Folsom/Natoma

1. Envisioning California's Water Future with the Collaboratory for Equity in Water Allocations (COEQWAL) – Wietske Medema (UC Berkeley)

2. Approach to evaluating winter-run Chinook salmon response to novel water allocation scenarios – Ann-Marie K. Osterback (UC Santa Cruz)

3. Connecting water management, climate, and drinking water availability for surface-water dependent water systems in Central and Southern California – Erik Porse (UC Agriculture and Natural Resources)

4. Salinity intrusion in a shifting Delta in a changing climate – Jenna Israel (UC Berkeley)

5. Assessing Environmental Flow Regimes in the Central Valley Under Alternative Management Scenarios – Sooyeon Yi (UC Berkeley)

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE.

ABSTRACTS

Session 1: CalSim 3 Updates and Applications
Session Moderator: Jonathan Byers (DWR)
Moderator Email: Jonathan.Byers@water.ca.gov

1. 2025 Delivery Capability Report Updates

Presenters: Jamel Lehyan (DWR)
Presenters Email Addresses: jamel.lehyan@water.ca.gov
Collaborators: Erik Reyes (DWR), Nazrul Islam, Andrew Schwarz, Romain Maendly, Wyatt Arnold, Alejandro Perez, Richard Chen, James Polsinelli, Mohammad Hasan, Jianzhong Wang, Raymond Hoang, Nicole Osorio, Zachary Roy, Jonathan Byers, Chris Quan, Devinder Dhillon, Malinda Wimalaratne, Hamed Zamanisabzi, Auhona Zaki, Yiwei Cheng (DWR); Nancy Parker (USBR); Tom FitzHugh, Andy Draper, Bridget Childs (Stantec); Chakri Malakpet, Jeffrey Weaver (HDR); Dan Easton, Shankar Parvathinathan (MBK); Tapash Das (Jacobs),
Permission to Post pdf of Presentation on CWEMF Website: Yes

The California Department of Water Resources is releasing the draft State Water Project Delivery Capability Report (DCR) for 2025 by the end of December. The DCR is used widely both within and outside the SWP for water supply planning. This presentation will provide an overview of the latest DCR existing conditions results compared with the previous 2023 DCR. Updates include code fixes and updates to the baseline CS3 model, mainly attributed to the new SWP Incidental Take Permit (ITP) and the federal Biological Opinions (Long-Term Operations of the CVP/SWP) that were approved in the fall of 2024.

2. CalSim 3 Historical Operations

Presenter: Nicole Osorio (DWR)
Presenter Email Address: nicole.osorio@water.ca.gov
Collaborators: Raymond Hoang, Yiwei Cheng, Zachary Roy (DWR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

CalSim 3 is a key model for CVP/SWP management and many other water-related planning activities. The model has been used for the Delivery Capability Report (DCR), Long-Term Operations (LTO) of the CVP/SWP, California Aqueduct Subsidence Program (CASP), and other major planning efforts (groundwater, urban, agricultural, regional). The purpose of the Historical Operations Study is to evaluate the ability of CalSim 3 to represent CVP/SWP operations and SWP delivery capability compared to historical operations. The complete analysis will focus on the recent ~25 years—since the Decision-1641's adoption in 1995—to capture the effect of changing regulations and operations. This presentation will focus on the D-1641 regulatory era and discuss how the hydrology and operational logic have been revised to reflect a particular regulatory environment compared to using a fixed level of development approach.

3. DCR 2023 Subsidence Addendum

Presenter: Zachary Roy (DWR)
Presenter Email Address: zachary.roy@water.ca.gov
Collaborators: Raymond Hoang, Jesse Dillion, James Lopes, Jonathan Byers (DWR); Bill Swanson (Stantec); Dan Easton, Shankar Parvathinathan, Gerardo Carrillo (MBK)
Permission to Post PDF of Presentation on CWEMF Website: Yes

The 2023 Delivery Capability Report (DCR 2023) provided estimates of both current and potential future delivery capabilities of the State Water Project. However, as noted in the report, the DCR 2023 did not account for the effects of subsidence in the San Joaquin Valley on the current or future delivery capability estimates. The DCR 2023 Impacts of Subsidence Addendum addresses that gap by evaluating the impacts of subsidence on the joint use and SWP facilities in the San Joaquin Valley. Attendees will learn about the analysis and conclusions presented in the Addendum.

4. Improvements to CVP Operations and Allocation

Presenter: Walter Bourez (MBK Engineers)
Presenter Email Address: bourez@mbkengineers.com
Collaborators: Dan Easton, Shankar Parvathinathan (MBK); Cameron Koizumi, Sam Waers, Nancy Parker (USBR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

CVP allocation to water service contractors is a highly scrutinized portion of the CalSim model. In CalSim, the process is meant to mimic the Central Valley Operation's decision making. Reclamation and MBK have worked to improve the CVP implementation in CalSim by using historical data to create metrics and generalized rules to more closely resemble real-time operations. A standardized methodology was then created for adjusting allocations due to changes to operations and/or infrastructure represented in CalSim.

Session 2: The Impact of Groundwater Pumping on Interconnected Surface Water: Technical Approaches and SGMA Compliance

Moderator(s): Vivek Bedekar (SSP&A) and Ali Taghavi (Woodard & Curran)
Moderator Email(s): vivekb@sspa.com; ataghavi@woodardcurran.com

The Sustainable Groundwater Management Act (SGMA), enacted in California in 2014, mandates the sustainable management of groundwater resources with a focus on balancing groundwater extraction with long-term replenishment. SGMA emphasizes the critical need to address groundwater depletion, but one of the often-overlooked consequences of increased groundwater pumping is its impact on interconnected surface water (ISW) bodies. Groundwater pumping, especially in regions where surface water and groundwater are hydraulically connected, can result in significant depletion of surface water flow and stage, with potential ecological, hydrological, and socio-economic implications.

Dealing with ISW depletion in Groundwater Sustainability Plans presents several challenges for groundwater managers, including that depletion cannot be measured directly and the significant time lag between pumping and depletion. Practitioners often rely on tools like analytical or numerical models to assess ISW depletion, but those tools come with their own constraints and associated uncertainty. This session will explore the technical aspects of modeling and understanding the depletion of ISW caused by

groundwater extraction under the constraints and goals set by SGMA. Presenters in this session will discuss recently published technical papers and a guidance document aimed at aiding practitioners in addressing the depletion of ISW, estimating ISW depletion in California basins, application of various methods and tools outside of California, and discuss conceptual uncertainties in modeling ISW depletion. Attendees will gain insights into the technical tools and approaches for evaluating the depletion of ISW systems while understanding the broader policy context of SGMA.

1. DWR's Interconnected Surface Water Depletion Guidance and Technical Papers

Presenter: Craig Altare (DWR)
Presenter Email: craig.altare@water.ca.gov
Collaborators: Ali Taghavi (Woodard & Curran) and Vivek Bedekar (S.S. Papadopulos & Associates)
Permission to Post pdf of Presentation on CWEMF Website: Yes

In addition to its other roles under the Sustainable Groundwater Management Act, DWR provides technical assistance to Groundwater Sustainability Agencies in the forms of data, technical information, and guidance. DWR has developed three technical papers and a guidance document to aid practitioners in addressing the depletion of interconnected surface water (ISW) in their Groundwater Sustainability Plans (GSPs). The overall aim of the topic papers was to discuss the technical aspects of assessing ISW depletion without considering *how* such depletion should be managed, which is the subject of the subsequent guidance document. The first paper included basic information on the interconnection between groundwater and surface water and defined that groundwater use (i.e., pumping) can deplete interconnected surface water. Paper two included general information on how practitioners can assess ISW depletion, including the data needed for such assessments and the types of methods commonly employed (e.g., analytical methods or numerical models). Paper two also discussed, in greater detail, the considerations for using numerical models to assess ISW depletion. Paper three provided examples of calculating ISW depletion using a numerical model for two hypothetical basins. The subsequent guidance document provides information on how ISW depletion can be addressed in the context of the requirements of SGMA and the GSP Regulations, including the consideration of beneficial uses and users, addressing current and historical depletion in the basin setting section of the GSP, developing sustainable management criteria like minimum thresholds and measurable objectives, and implementing monitoring networks. This talk will cover the information provided in the papers and guidance document and provide important context on the policy and regulatory requirements of SGMA for subsequent discussions in this session.

2. Best Available Science: Navigating Data Limitations Associated with Depletions

Presenter: Sercan Ceyhan (Woodard & Curran)
Presenter Email: mceyhan@woodardcurran.com
Collaborators: Jim Blanke, Andres Diaz, Dominick Amador (Woodard & Curran)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Depletions of interconnected surface waters is perhaps the most technically challenging to characterize, monitor, and manage of the six sustainability indicators under SGMA. Yet, this is what Groundwater Sustainability Agencies are tasked with. Even the seemingly basic step of characterizing historical and existing depletions is challenging due to limitations of data and tools. In 2024, while DWR was developing topic papers and guidance on depletions, GSAs were moving forward with evaluating and updating their Groundwater Sustainability Plans. In most cases, this included consideration of a Recommended

Corrective Action from DWR to improve the characterization of the location, timing, and quantity of depletions. This talk will explore paths taken by selected GSAs to improve their characterization of the location, timing, and quantity of depletions. The GSAs arrived at different end-points depending on the nature of their subbasin and the nature of the available data and tools. Considerations and lessons-learned will be discussed, along with how the experience relates to the newest guidance from DWR.

3. Application and Comparison of Methods and Interfaces for Estimating Stream Depletion to Develop Management Alternatives in the Intermountain West

Presenter(s): Gilbert Barth and Matthew Tonkin (S.S. Papadopulos & Associates)
Presenter Emails: gbarth@sspa.com; matt@sspa.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

The potential for groundwater withdrawal to deplete surface water flows is an increasing concern nationwide. In many western states this potential is complicated where surface water rights are senior, and there is the potential for groundwater withdrawals to impair those senior rights. Such potential must be evaluated, in terms of both the likely quantities and timing of stream depletion. The potential for both near-term (and short-duration) and long-term (and extended-duration) impairment of surface water flows needs to be understood, evaluated, and effectively communicated to a wide range of parties. Over 40 years SSP&A has implemented a wide variety of analytical and numerical methods for this purpose and has developed several flow-depletion estimation interfaces and techniques to facilitate thorough assessments. These methods are in use in numerous states for entities ranging from private industry to state and federal agencies. This presentation presents examples using a variety of (a) commonly used, (b) newly developed, and (c) customized calculation methods and tools. First, the most common analytical methods are presented and described. Next, newly developed numerical methods are presented and contrasted with the simpler analytical methods to demonstrate the added inference numerical methods can provide. Third, customized geo-graphical interfaces are presented that were developed by SSP&A specifically to enable rapid scenario configuration and that produce a range of graphical and tabular summaries to communicate depletion potential, providing spatial and temporal insights necessary to develop management alternatives and mitigations strategies. The computational underpinnings of these customized interfaces range from analytical solutions implemented on river networks through to regional numerical models incorporating complex hydrogeology. Specific examples range from tools developed for state agencies to rapidly evaluate proposed pumping and place-of-use changes, through hybrid tools implementing the state engineer's administrative numerical groundwater model or analytical solutions, to tools adapted to incorporate Modflow-6 models for rapid assessment of stream depletion.

4. Conceptual Uncertainties in Modeling Depletion of Interconnected Surface Water

Presenter: Tyler Hatch (INTERA)
Presenter Email: thatch@intera.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

Depletion of Interconnected Surface Water, or Capture, is an important consideration for understanding how pumping affects users of surface water, including environmental users of surface water and water rights holders. The Sustainable Groundwater Management Act (SGMA) identifies Depletion of Interconnected Surface Water as one of the six undesirable results requiring Groundwater Sustainability Agencies (GSAs) to identify interconnected surface water in their Basins. If interconnected surface water exists, the GSA must develop sustainable management criteria for depletion of interconnected surface

water. Since depletion of interconnected surface water cannot be directly quantified using field measurements, modeling via either analytical or numerical methods is the primary way to quantify the location, rate, and timing of depletion. However, significant uncertainty remains due to conceptual limitations of the methods available. This talk discusses some of these limitations and invites discussion for ways of overcoming these in practical ways to make management decisions and meet the regulatory requirements of SGMA. Examples (not inclusive):

1. Disconnection/reconnection – neither numerical models nor analytical methods provide a physically based method for when disconnection or reconnection occurs.
2. Representation of all interconnected surface water bodies in a numerical model – unlined canals, temporary or permanent reservoirs, and small ephemeral streams are often not represented in regional models and analytical methods typically assume a single stream which can affect the estimates of location and timing of depletion
3. Streamflow routing in regional groundwater models tend to be focused on flow rather than stage, but stage is a key component of estimating the gradient between surface water and groundwater. In such cases, rating tables may be used to represent stage. However, rating tables often are highly uncertain at low flows and high flows, with the former being a critical time for potential impacts to beneficial users of surface water.
4. Simulating low flow conditions - Low flows can also be challenging since depletion under low flow conditions may be within the numerical error of the model.

Session 3: Connecting Data with Users: Open Water and Ecological Data and Tools
Moderator: Christina McCready (DWR)
Moderator Email: christina.mccready@water.ca.gov

This session is designed to connect data (and data producers) with data users and their use cases. The first presentation will demonstrate key data and tools available from the State Water Boards. The second and third presentations will share tips and insights on using the State's open data portals as well as previews of upcoming features. The fourth presentation will introduce open data publication work at the State. The last talk will be interactive to engage the audience in a conversation about their experiences using open data, tools, and use cases.

1. Introduction to Open and Transparent Water Data Publication at Department of Water Resources

Presenter(s): Mitch Russo & Mahesh Gautum (DWR)
Presenter(s) Email Address(es): Mitchel.Russo@water.ca.gov; Mahesh.Gautam@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

Introduction of the publication process for Open Data by the State with a focus on DWR specific implementation. The presentation will go over the desired goals of publishing to an open data portal including formats, critical content, metadata and many other elements. DWR's open data handbook and publishing guides will be highlighted as documentation of DWR's processes as well as the various working groups at DWR that are working to ensure the availability and usability of published data. Recent federation efforts with locally held data and CDEC will also be highlighted to demonstrate work being done to increase the discoverability of water-related data resources.

2. Open Data and Tools Available from the Water Boards

Presenter: Rafael Maestu (SWRCB)
Presenter Email Address: rafael.maestu@waterboards.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: YES

The Water Boards are committed to making their public data and tools publicly available and passed an open data resolution on July 10, 2018. Much of the Water Boards complex data ecosystem exists independently of each other and is managed by each respective program (data owners). The Water boards has invested significant time and effort to publish a selected list of data resources onto the State of California data portal but we still have many more datasets that are not publicly available. Goal of the water boards data publication is to make it accurate, reliable, documented, complete, up to date, with all needed data elements to ensure the usefulness of the data. The datasets must be in machine readable format (flat files, long format, etc) documented with a data dictionary and properly described, including a point of contact for questions. Some datasets are available directly from the Water boards website, but the policy is to publish all public data on the California Open Data Portal (ca.data.gov) following the Open and Transparent Water Data Act Protocols. Presentation will include a demonstration of how to access various critical Water Board data resources online including Water quality, water rights, and water conservation.

3. Overview and Advanced Features of the CNRA Open Data Platform

Presenter: David Harris (DWR)
Presenter Email Address: david.harris@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

Overview of functions of the California Natural Resources Agency (CNRA) Open Data Platform, which has been instrumental in pulling together all water related data in California to satisfy the requirements of the Open and Transparent Water Data Act. Presentation will include an overview of how federation between CNRA Open Data Platform and other data systems that form the federated open data platforms work together to make data discoverable. Presentation will include a demonstration of advanced capabilities on the platform to increase user success in locating and utilizing the data they are looking for. A few advanced capabilities covered will include geospatial tagging tools, data filtering, and advanced search. A preview of new features coming to the platform in the near future will highlight exciting upcoming possibilities when working with the platform.

4. Open Data Availability: How to Access Data Efficiently Using CKAN API

Presenter: Aaron Cuthbertson (DWR)
Presenter Email Address: Aaron.Cuthbertson@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

Application Programming Interfaces (APIs) are available on the California Natural Resources Agency (CNRA) Open Data Platform to make it easier to connect and utilize the data published by State entities. These APIs provide a direct connection to the data that allows you to connect to the data and support

activities like scripting and querying the data without having to download and work with a local copy. Using an API ensures that you are always accessing the most up to date version of the data resource you are interested in. The talk will provide a broad overview of the available APIs for CNRA Open Data, list where to go for more information, and walk through several examples of querying the portal and data within individual resources. Utility of the API resources will be demonstrated through some examples. Come to learn how to leverage these key open data resources in your work more effectively.

5. Interactive Dialog – Improving the Usability of Data and Data Portals

Presenter: Robyn Grimm (California Water Data Consortium)
Presenter(s) Email Address(es): rgrimm@cawaterdata.org
Collaborators: Christina McCready (DWR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

A brief introduction to the California Water Data Consortium followed by an interactive dialog to engage the audience in a conversation about their experiences using open data, tools, and use cases. The discussion will seek to better understand how current state open data efforts are being received and what could be done to improve both the discoverability and the usefulness of state datasets on the open data portals. The presenter will share some prepared questions with the audience designed to help the audience consider and share their experiences working with state data and prioritize areas for improvement. Join us for a chance to get attention on your specific data needs!

Session 4: 3DHP: Updates on the Representation of Groundwater in CalSim
Moderator: Can Dogrul (DWR)
Moderator Email: can.dogrul@water.ca.gov

Passage of the Sustainable Groundwater Management Act (SGMA) along with climate change brought new emphasis on the groundwater resources of California and their impact on surface water management. California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (BOR) have been working to improve the representation of groundwater flow dynamics in CalSim. These efforts include the recalibration of the Coarse Grid California Central Valley Groundwater-Surface Water Simulation Model (C2VSimCG) which provides the physical representation of the Central Valley aquifer in CalSim, and a new groundwater dynamic link library (GWDLL) consistent with the groundwater simulation component of C2VSimCG. This session will include talks detailing these efforts along with analyzing the impact of groundwater on stream flows and reservoir operations as simulated by CalSim, and ongoing work to better streamline C2VSimCG and CalSim to provide a modeling platform for more efficient simulation, analysis and planning of the Central Valley water resources.

1. *Calibration of the California Central Valley Groundwater-Surface Water Simulation Model – Coarse Grid (C2VSim-CG)*

Presenter: Steven Jepsen (DWR)
Presenter Email: steven.jepsen@water.ca.gov
Collaborators: Emin Dogrul, Tariq Kadir, Shalamu Abudu, Ali Ghaseminejad (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The California Central Valley Groundwater-Surface Water Simulation Model – Coarse Grid (C2VSim-CG) is being calibrated to improve the accuracy of simulated groundwater levels and streamflows relative to historical observations. Our approach is to estimate all parameters in a single calibration run, using PEST_HP on the cloud (PEST.cloud), and include errors in groundwater level and streamflow in the objective function. We have so far added aquifer parameters and streambed hydraulic conductivity to the calibration. In addition, we updated potential ET input data. The calibration work to date has lowered the mean absolute error in groundwater level by 39%, from 29 ft to 18 ft, and has lowered the mean absolute error in streamflows by 28%, from 51.8 to 37.4 taf/month. Parameters of the unsaturated zone and root zone still need to be added to the calibration.

2. *C2VSimCG and CalSim 3 Alignment updates*

Presenter: Malinda Wimalaratne (DWR)
Presenters Email: Malinda.wimalaratne@water.ca.gov
Collaborator: Can Dogrul (DWR)
Permission to Post pdf of Presentation on CWEMF Website: yes

The integration of the California Central Valley Groundwater-Surface Water Simulation Coarse Grid Model (C2VSimCG) and the California Water Resources Simulation Model (CalSim 3) is critical for improving water resource planning and management. C2VSimCG provides a comprehensive representation of groundwater and surface water interactions, while CalSim 3 is a decision-support model used for large-scale water allocation planning. Two models have been independently improved over time in different aspects, and for that reason, it required to maintain different code sets. This causes a big challenge in integration of two models during bug fixes and intermediate improvements. Recent upgrades to C2VSimCG from r374 to C2VSimCG v1.0 include the addition of new stream reaches and an increase in groundwater layering up to four layers, enhancing the model's ability to represent subsurface flow dynamics. Concurrently, CalSim 3 has undergone code updates to refine stream-groundwater connectivity, updated tiledrain representation, and groundwater head and stream head parameterization. Two models are coupled through Ground Water Dynamic Linked Library (GWDLL) and used DCR 23 CalSim 3 released version for the comparison and analysis provided in this study.

3. Automated Calibration Workflow for the GW-DLL

Presenters: Sercan Ceyhan & Ali Taghavi (Woodard & Curran)
Presenters Email: mceyhan@woodardcurran.com, ataghavi@woodardcurran.com
Collaborators: Bridget Childs, Puneet Khatavkar (Stantec); Ryan Lucas, Nancy Parker, Lauren Thatch (USBR)
Permission to Post pdf of Presentation on CWEMF Website: YES

The GW-DLL module in CalSim plays a critical role in simulating groundwater interactions, including stream accretions and depletions, which directly influence surface water flows and reservoir conditions. Given the importance of these interactions, accurate calibration of GW-DLL is essential for reliable CalSim results and the planning studies that rely on them. This study presents an integrated workflow for calibrating the groundwater component in CalSim using PEST, while accounting for uncertainties introduced by the CalSim Demand Calculator (CalSim-Hydro). We will outline the calibration process, including the PEST setup—focusing on key parameters, observations, pre- and post-processors and lessons learned—to improve the accuracy and robustness of groundwater-surface water simulations.

4. Aligning C2VSimCG and CalSim Applications for Future Modeling Needs

Presenter: Can Dogrul (DWR)
Presenters Email Addresses: can.dogrul@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

20 years ago, DWR and USBR had the right idea: Instead of developing brand new models to develop hydrology for and simulate groundwater in CalSim, use existing models. This idea led to the development of CalSimHydro based on the land surface and root zone component of IWFM, and the groundwater DLL, the groundwater component of IWFM populated by data from a calibrated C2VSimCG. However, over the years, both the numerical engines used for C2VSimCG and CalSimHydro and the applications themselves went their own way with little regard to each other. It became very hard to transfer data between C2VSimCG and CalSim as well as to verify and cross check modeling results. Today, there is a new effort to better streamline underlying numerical engines for C2VSimCG and CalSimHydro along with the applications of CalSim and C2VSimCG. This talk will outline the need for this effort and provide details on the tasks to be performed to better streamline the C2VSimCG and CalSim applications, and list the expected benefits for future modeling studies.

Session 5: California Water Plan: The Future is You
Moderator: Paul Shipman (DWR)
Moderator Email: Paul.Shipman@water.ca.gov

1. *California Water Plan Update 2023 – Roadmap to Resilience and benefits of being involved in Water Plan*

Presenter: Lewis Moeller (DWR)
Presenter Email Address: lewis.moeller@water.ca.gov
Collaborators: Paul Massera, Kamyar Guivetchi (retired), William O'Daly (retired)
Permission to Post PDF of Presentation on CWEMF Website: Yes

The California Water Plan Update 2023 is a comprehensive plan intended to increase understanding of the pressing issues, uncertainties, and vulnerabilities in California water management today and to resolve them by aligning existing and proposed water initiatives. This presentation will include a high-level overview of the California Water Plan Update 2023 with a focus on the roadmap to resilience, offering a concrete vision for the future of the state's water management. To meet the plan's objectives and enhance resilience, specific enabling conditions are necessary:

- State government enacts enabling water policies and legislation to adapt to the evolving needs of California's water management.
- Local and regional water sectors and jurisdictions engage in planning and collaborating within watersheds to jointly assess their climate vulnerabilities, evaluate multi-sector adaptation strategies, and implement multi-benefit projects to improve regional and inter-regional resilience.
- Communities of interest and elected officials address climate urgency; enhance watershed resilience; promote equity in water management; and make a commitment to learning and adapting by tracking progress and outcomes with consistent indicators and metrics.

2. *Menu of Water Plan Activities*

Presenter(s): Eric Tsai, Megan Fidell, Lucian Filler, Jennifer Stricklin, Paul Shipman (DWR)
Presenter(s) Email Address(es): eric.tsai@water.ca.gov, megan.fidell@water.ca.gov, lucian.filler@water.ca.gov, jennifer.stricklin@water.ca.gov, paul.shipman@water.ca.gov
Collaborators: Lew Moeller, Jose Alarcon, George Valente, James Common, Paul Wells, Hoa Ly (DWR); Melissa Stine, Jeanna Long (W&C); Brian Joyce, Chuck Young, Andrea Carlos-Carlos (SEI)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Preparing an effective and influential Water Plan requires essential data, analyses, and information. The presentation will include a brief update on the following projects:

- Building the resilience of California's watersheds through the watershed resilience pilots.
- Providing building blocks for multi-benefit water management portfolios by documenting and updating resources management strategies, which include water management actions available to meet resource needs.
- The Watershed Hub provides a snapshot of projects, data, conditions, and trends based on indicators in each watershed to support Watershed Networks, show progress toward sustainability and resiliency, identify risks, address vulnerabilities, identify and track multi-benefit projects, assess return on investment, and inform funding decisions.
- Understanding where we are now is necessary to inform where we want to be. The Water Use and Supply balances, as the sole documentation of statewide water conditions stretching back to

1998, have been a cornerstone of the state's planning process. These comprehensive datasets have been utilized in extensive analyses throughout California.
- Planning for the future is critical to ensure the state's continued prosperity and water security. The future scenarios examine the likely impacts of population and climactic changes on the state's water resources relative to current conditions.

3. Interactive dialog with session attendees on concepts of Water Plan Update 2028

Presenter: Paul Massera (DWR)
Presenter(s) Email Address(es): paul.massera@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

Join an interactive dialog about the water management challenges, issues, and opportunities confronting California decision-makers in the next few years. Utilize a chance to share your understanding of the needs and challenges the state will be facing. The discussion will seek to leverage CWEMF's expansive technical knowledge to understand critical areas of focus in California water management. The presenter will propose a series of questions designed to elicit audience feedback around current water management areas of focus.

Session 6: Accounting for System Flows, Consumptive Use, and Water Availability in the Sacramento-San Joaquin Delta Basin
Moderator: Will Anderson (SWRCB)
Moderator Email: will.anderson@waterboards.ca.gov

1. *Parsing Flows in the Sacramento-San Joaquin Watershed: What We Don't Know, But Need to Know –*

Presenter: Greg Gartrell (Public Policy Institute of California)
Presenter Email Address: gxg2048@gmail.com
Permission to Post PDF of Presentation on CWEMF Website: ???

Tracking water sources, water uses, and Delta outflow in the Sacramento-San Joaquin watershed requires detailed water monitoring and accounting systems. Despite some recent improvements, information on some key measures—such as upstream and in-Delta depletions—is still limited. This is important because our analysis indicates that water use upstream of the Delta is increasing. The climate of the Delta watershed is changing, with a significant rise in temperatures over the past few decades. Several key trends have emerged: Upstream use is rising—and Delta inflow falling; maintaining salinity is requiring more outflow; environmental regulations have also increased Delta outflow relative to runoff, stopping a long-term declining trend. However, gaps in data make modeling and forecasting difficult: while upstream depletions are increasing, we don't know how much is riparian ET, how much is seepage to groundwater, nor how much is diverted, used, or returned to the system. Similarly, we don't have real-time channel depletions in the Delta that are needed to accurately calibrate salinity models.

2. *Water Rights Reporting & Measurement, the Delta Alternative Compliance Plan, and Support for a New Delta Water Balance*

Presenter: Will Anderson (SWRCB)
Presenter Email Address: will.anderson@waterboards.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: ???

Recent progress in obtaining complete and consistent water rights reporting datasets has brought into focus the capabilities and limitations of diversion measurement and consumptive use estimation methods to characterize the Sacramento-San Joaquin Delta. For decades, California's water management agencies have faced challenges in assessing flow conditions in the Delta's tidal estuary, and in planning operations and allocations of available water supply in a context of significant risks and tradeoffs. Subsequent to the Senate Bill 88 measurement statute, water users have collaborated with the State Water Board's Office of the Delta Watermaster in the development of the Delta Alternative Compliance Plan (Delta ACP), which uses OpenET remote sensing methodology to estimate annual consumptive use from evapotranspiration of irrigated crops, in lieu of installation of expensive flow gages on over 3,000 diversions. This talk will summarize recent annual reports of diversion and consumptive use and review foundational assumptions and data gaps in the understanding of in-Delta water use.

3. *Accounting Framework for Implementing the Proposed Agreements for Healthy Rivers and Landscapes*

Presenter: TBD (DWR)
Presenter Email Address:
Permission to Post PDF of Presentation on CWEMF Website: ???

Many of the California water agencies proposed the Agreements for Healthy Rivers and Landscapes (HRL) as an alternative to be considered as part of the ongoing State Water Resources Control Board's Bay-Delta Water Quality Control Plan Update. HRL includes a series of flow and habitat commitments on several Delta watershed tributaries. The California Department of Water Resources (DWR) staff have developed an accounting methodology in coordination with Reclamation and the HRL parties that demonstrates the successful implementation of the HRL flow commitments. This talk summarizes the HRL flow commitments and how the flow accounting in the tributaries and in the Sacramento-San Joaquin Delta would work in the context of ongoing State Water Project (SWP) and Central Valley Project (CVP) operations.

4. *Actions and Accounting to Make Water Available*

Presenter(s): Lee Bergfeld & Wesley Walker (MBK Engineers)
Presenter Email Address: bergfeld@mbkengineers.com; walker@mbkengineers.com
Permission to Post PDF of Presentation on CWEMF Website: ???

ABSTRACT NOT AVAILABLE

Session 9: Delta Simulation Model II Improvement
Moderator: Xiaochun Wang (DWR)
Moderator Email: Xiaochun.Wang@water.ca.gov

The Delta Simulation Model II (DSM2) plays an important role in assessing the effectiveness of various water resources management actions. The model empowers water resources managers by providing insights into the potential impact of these management actions, thereby facilitating well-informed decision-making regarding their implementation. Since its initial release to the public, DSM2 has undergone continuous recalibration and improvement to meet the evolving demands of water resource management. This session highlights recent advancements in the model, including improvements to the DSM2 Cross-Section Development Program (CSDP). These enhancements incorporate new features designed to optimize the utilization of higher density bathymetry. Furthermore, the model has been fine-tuned for the South Delta using an inverse modeling approach for characterizing unknown sources of salinity. These refinements contribute to a more accurate simulation of hydrodynamics and salinity transport in the southern Delta. To enhance the model's capabilities, cloud computing has been incorporated to perform simulations for the Ecological Particle Tracking Model (ECO-PTM). This integration enables a more comprehensive analysis of long-term ecological trends. As a result of the model's ongoing improvements, we ensure its sustained performance and relevance over time, enhancing its value as a vital tool in water resource management.

1. Update: DSM2 Cross-Section Development Program (CSDP)

Presenter: Bradley Tom (DWR)
Presenter Email: Bradley.Tom@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

The Cross-Section Development Program (CSDP) is used to create geometry for the Delta Simulation Model II (DSM2), a one-dimensional hydrodynamics, water quality, and particle tracking model. This presentation will describe some of the tools recently added to the CSDP to help the user mitigate impacts of geometry variations upon the numerical stability of the DSM2 hydrodynamics model, create shapefiles used for GIS grid maps, automate the process of generating cross-sections, and create output locations for DSM2.

2. Inferring unknown salinity loads using a response-based inverse modeling method

Presenter: Zhenlin Zhang (DWR)
Presenter Email: Zhenlin.Zhang @water.ca.gov
Collaborators: Eli Ateljevich (DWR)
Permission for CWEMF to post pdf of presentation: Yes

South Delta salinity is influenced by numerous factors, including San Joaquin River inflow and water quality, agricultural barriers, export volumes, ocean salinity intrusion and in-Delta sources of salt. Many of these factors are well-understood or can be modeled using available data. This is not the case for in-Delta sources of salinity, which are spatially distributed, unmonitored and in some cases (e.g. interaction with salty groundwater) unmonitorable in the traditional sense. In this talk we describe an inverse modeling approach for characterizing unknown sources of salinity. The method was developed under the Monitoring Special Study (MSS), a comprehensive field and monitoring evaluation of South Delta

dynamics that is a requirement in the State Water Resources Control Board's 2018 Bay-Delta Plan to inform the Comprehensive Operations Plan. The inferences are algorithmic, using DSM2 (a one-dimensional model of the Delta) as the physical model and a novel regularization that encourages a small number of sources. The results indicate the South Delta can be understood based on relatively simple salinity loads mostly located in Middle River, Paradise Cut, and nearby sections of Old River. Model simulations incorporating the inferred sources compare favorably to independently obtained high speed transects of salinity and have been corroborated using a second 3D model, Bay-Delta SCHISM. An important role of the project within MSS is to evaluate the influence of San Joaquin River, Central Valley Project and State Water Project exports, and agricultural barriers -- the credo in this case being that 'models cannot evaluate the value of flushing flows if the salinity that is flushed isn't in the model'. Future work will focus on generalizing what is learned to planning simulations.

3. Integrating Cloud Computing Capability to ECO-PTM Simulations

Presenter: Xiaochun Wang (DWR)
Presenter Email: Xiaochun.Wang@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

ECO-PTM is an individual-based ecological particle tracking model (ECO-PTM). Based on a random walk theory, the model tracks individual particles' travel time, routing and survival in a flow field simulated by the Delta Simulation Model 2 hydrodynamic module (DSM2 HYDRO). It has been used to assess the efficacy of proposed water management actions. However, two key factors pose challenges in utilizing this model effectively. First, its stochastic nature introduces inherent randomness. Second, the simulated particle travel and survival outcomes depend on the specific locations and times at which particles are inserted. Consequently, conducting a comprehensive analysis of long-term ecological trends demands a substantial number of simulations. To address this, we have utilized the power of cloud computing for extensive simulation runs for various studies. Our talk aims to share insights into our experiences in cloud computing, focusing on how to set up a cloud computing service for an ECO-PTM study. We will also discuss scalability, data storage and model performance aspects of cloud computing to understand how cloud computing can help in achieving our objectives.

4. Clifton Court Forebay: gate characterization and operational effect study

Presenter: Sophie Munger (DWR)
Presenter Email: Sophie.Munger@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

This presentation shows the result of an effort to understand better the effects of manipulating the SWP Clifton Court Forebay intake gate schedule on the water level and water quality in the South Delta. It includes the steps taken to revamp the gate characterization in Delta Simulation Model II (DSM2) and the SCHISM to create a realistic and adaptive gate-operation characterization for modeling hypothetical scenarios.

5. New EC-based operating rule in DSM2

Presenter: Yujia Cai (DWR)
Presenter Email: Yujia.Cai@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

The Delta Simulation Model 2 (DSM2) is a widely used one-dimensional hydrodynamics and water quality modeling suite for the Sacramento–San Joaquin River Delta. One of its key features is the ability to dynamically control devices, such as gates, based on simulated hydrodynamic conditions on the fly. We have enhanced the operating rule code to enable device operation based on water quality parameters. To achieve this, we coupled DSM2's hydrodynamics module (Hydro) with its water quality module (GTM) and implemented a new operational trigger based on electrical conductivity (EC). This presentation provides an overview of the newly implemented EC-based operating rule, demonstrating its application through two case studies. This new feature can serve as a valuable tool for evaluating operational alternatives in the Delta.

Session 10: Advances in Aquifer Recharge Modeling

Moderator: Merberu Meles (USDA)
Moderator Email: menberu.meles@usda.gov

Hydrological models are vital for understanding the complex interactions between surface and subsurface water systems. In regions like California, where groundwater serves as a cornerstone of agricultural production and domestic water supply, overexploitation has led to critical challenges such as aquifer depletion, land subsidence, and groundwater quality degradation. Developing and applying advanced modeling tools and techniques that provide reliable insights into water quantity and quality are essential for sustainable groundwater management. Managed aquifer recharge (mar) technologies have emerged as promising solutions to enhance groundwater storage, mitigate environmental impacts, and provide socio-economic benefits. By intentionally directing excess water—such as surface water, stormwater, or treated wastewater—into aquifers, mar can play a pivotal role in addressing water scarcity and related challenges. This session will highlight advances in aquifer recharge modeling, featuring innovations in simulation, optimization, and evaluation of mar technologies. It will provide a platform for researchers, practitioners, and policymakers to share insights on designing and implementing mar strategies across diverse hydrogeological regimes and scales.

1. Sensitivity Analysis of Groundwater Recharge to Soil Properties in the Central Valley

Presenter: Jiao Wang (UC Davis)
Presenter Email: jaowang@ucdavis.edu
Collaborators: Menberu Meles & Scott Bradford (USDA); Thomas Harder (UC Davis)
Permission for CWEMF to post pdf of presentation: Yes

Groundwater recharge is a critical component of water resource sustainability, particularly in regions facing severe groundwater depletion, such as California's Central Valley, a vital agricultural hub in the US. Soil properties and their vertical distributions exert a significant yet complex influence on recharge dynamics, with uncertainties persisting in how these factors regulate water movement and storage. This study examines the sensitivity of groundwater recharge to variations in soil texture and layering within the unsaturated zone using the Hydrus-1D model, a widely validated tool for simulating unsaturated flow. Through simulations of diverse soil profiles across multiple scenarios specific to the Modesto-Turlock-

Merced subbasins in Central Valley, we employ a global sensitivity analysis to assess the impacts of soil properties and vertical heterogeneity on recharge rates, residence times, water content, and signal shifts at varying depths. The research seeks to address key questions: How do different soil types and layering influence recharge dynamics? What role does vertical soil structure play in water flux and storage? Expected outcomes include a deeper understanding of the interplay between soil properties and recharge processes, providing insights into whether detailed vertical profiling and advanced modeling are essential for accurate predictions in vadose zone. These findings will contribute to refining the parameterization of unsaturated zone processes in hydrological models, enhancing strategies for managed aquifer recharge by optimizing water infiltration and storage, ultimately supporting more effective groundwater management in diverse soil environments like those of the Central Valley.

2. Optimizing Managed Aquifer Recharge (MAR) at a Hillslope Scale in California's Central Valley

Presenter: Xinying Ling (UC Riverside)
Presenter Email: xinyingl@ucr.edu
Collaborators: Menberu Meles & Scott Bradford (USDA); Hoori Ajami (UC Riverside)
Permission for CWEMF to post pdf of presentation: Yes

Managed aquifer recharge (MAR) is a strategic approach to replenishing groundwater resources, enhancing water security, and mitigating the impacts of droughts and over-extraction by intentionally directing surface water, stormwater, or treated wastewater into aquifers. Previous research on MAR has been mostly focused on flat agricultural lands, floodplains, or river-adjacent areas; however, the mechanisms of hillslope MAR and its effectiveness on increasing aquifer storage remain largely unexplored. To assess the role of topographic and subsurface hydraulic properties on hillslope MAR implementation in California's Central Valley, we developed and applied a coupled surface-subsurface model using MIKESHE at a hillslope scale. Model scenarios include assessing river-unsaturated zone-groundwater interactions due to pumping and injection wells at different locations, and examining their sensitivity to variations in slope, hydraulic conductivity, and bedrock geometry under varying hydroclimatic conditions (arid, semi-arid, and humid). Preliminary results indicate that the spin-up time to stabilize groundwater storage under dry conditions (170 years with 250 mm/yr precipitation) is significantly longer than wet conditions (70 years with 1000 mm/yr precipitation). Under dry conditions, overland flow is negligible, with 75.7% of precipitation lost to evapotranspiration and 24% recharging the subsurface. In contrast, under wet conditions, overland flow and evapotranspiration constitute 11.6% and 40.5% of the water budget, respectively, and 47.9% of precipitation becomes recharge. Pumping wells create localized cones of depression in the valley floor and hillslope, with broad-scale drawdown near the river. Our preliminary results suggest that MAR implementation at the hillslope scale is effective, by leveraging strong hydraulic gradients to enhance valley aquifer recharge. This study provides valuable insights for improving groundwater management by optimizing groundwater extraction strategies, and guiding MAR applications in California's Central Valley and similar regions.

3. *Spatio-Temporal Modeling of Groundwater Flow Dynamics Under Extensive Irrigation in the San Joaquin Valley*

Presenter: Tibebe Tigabu (UC Riverside)
Presenter Email: tibebe.tigabu1@ucr.edu
Collaborators: Alberto Casillas-Trasvina (UC Davis); Menberu Meles & Scott Bradford (USDA); Ryan Bailey (Colorado State U), Jiri Simunek (UC Riverside)
Permission for CWEMF to post pdf of presentation: Yes

The recurring droughts in California have significantly impacted groundwater resources. In the San Joaquin Valley, increasing agricultural water demand has led to excessive groundwater pumping, exacerbating overdraft conditions. Understanding the spatiotemporal dynamics of groundwater flow is essential for the effective implementation of the Sustainable Groundwater Management Act (SGMA). In this context, physically based models serve as vital tools for predicting current and future water resource availability. This study models the groundwater flow dynamics of the Turlock-Merced-Modesto area using the newly developed physically based, spatially distributed groundwater flow module (GWFLOW) of the SWAT+ model. While SWAT+ is a catchment-scale model that simulates hydrologic processes based on hydrologic response units (HRUs) and channel routing, large-scale groundwater modeling can be computationally demanding. To improve efficiency, we developed a fine-scale model by downscaling the larger catchment while incorporating upland flow contributions through point sources. Additionally, the SWAT+ water allocation module was applied to estimate groundwater withdrawals from individual irrigation wells based on water stress conditions. Our results indicate that groundwater storage and water table levels have been declining over time due to an imbalance between natural recharge and pumping. Between 2001 and 2022, groundwater pumping accounts to 175% of the predicted recharge, leading to a steady decline of groundwater storage in the basin. Overall, this study demonstrates that integrating the GWFLOW and water allocation modules of SWAT+ provides valuable insights into the groundwater flow dynamics of the Central Valley, supporting sustainable water management efforts.

4. *An Externally Coupled Multi-Model Framework for Integrated Surface-Subsurface Flow and Solute Transport on Hillslopes*

Presenter: Sakiur Rahman (UC Riverside)
Presenter Email: atmsakir@ucr.edu
Collaborators: Jiří Šimůnek & Hoori Ajami (UC Riverside); Scott Bradford & Menberu Meles (USDA); Lin Chen (Chinese Academy of Sciences); Adam Szymkiewicz (University of Krakow, Poland)
Permission for CWEMF to post pdf of presentation: No

Process-based hydrologic models are vital for understanding and assessing the impacts of management practices and natural disturbances on landscapes. However, fully distributed physics-based models have been limited to small areas and short time frames due to the computational challenges of solving three-dimensional surface-subsurface flow. This study presents the development, numerical testing, and initial application of an enhanced coupled surface-subsurface flow and solute transport modeling framework. The framework integrates HYDRUS-1D (H1D) for vadose zone flow, KINEROS2 (K2) for overland flow, and MODFLOW-2005 (MF5) for groundwater flow, and MT3DMS for solute transport, forming a multi-domain, physically based simulation tool referred to as H1D-K2-MF5-MT3. Key integration innovations in this

framework include boundary switching based on surface ponding, dynamic time-stepping, and the exchange of flow and solute fluxes across the surface-vadose zone-groundwater interfaces. Model accuracy was evaluated through benchmark simulations across various hillslope conditions. The results demonstrated strong agreement in hydrographs, chemographs, soil solute profiles, and groundwater concentrations when compared with reference models. The framework effectively captured the spatiotemporal flow and solute transport dynamics, including overland flow, infiltration, vadose zone leaching, and advective–dispersive transport in groundwater at the hillslope scale. This robust and flexible modeling tool provides a valuable foundation for assessing the fate and transport of contaminants in complex hydrological systems. Future work will incorporate reactive solute processes and explore applications at the watershed scale.

5. Drivers of Soil Moisture Dynamics over Continental United States

Presenter: Mashrekur Rahman (UC Davis)
Presenter Email: mashrekur.rahman@usda.gov
Collaborators: Menberu Meles & Scott Bradford (USDA); Grey Nearing (Google, Inc.)
Permission for CWEMF to post pdf of presentation: Yes

Soil moisture dynamics are central to hydrological processes, shaping runoff generation, infiltration, groundwater recharge potential, drought stress, and water availability. To better understand the complex drivers of soil moisture dynamics, we introduce a novel spatially-aware Vision Transformer (ViT) architecture that captures both local and regional influences across the Continental United States (CONUS) while accounting for heterogeneity. Our approach integrates data from 360 International Soil Moisture Network (ISMN) stations with comprehensive environmental data, including ERA5 climate reanalysis, USGS elevation products, MODIS land cover, and SoilGrids soil characteristics. Results show systematic improvement in prediction skill with increasing forecast horizons, with 177 stations improving at 48 hours (+0.138) and 180 stations at 72 hours (+0.140). Our model demonstrates particularly strong performance in regions with complex terrain and diverse vegetation. A dual-method feature importance analysis of Cohen's d and SHapley Additive exPlanations (SHAP) values calculation reveals that precipitation patterns distinguish station performance (Cohen's d = 0.40-0.65) but have low predictive importance (SHAP < 0.03), while solar radiation shows the opposite trend (SHAP = 0.12-0.13). This suggests that while precipitation dictates where the model performs best, the evaporative demand drives soil moisture changes. Clay content emerges as a temporal gatekeeper, with a +256% increase in importance at longer prediction horizons, while water retention near field capacity remains consistently important. The evolution of feature relationships across prediction windows reveals complex soil-environment interactions beyond traditional models. This work advances our understanding of soil moisture processes at continental scales, supporting improved hydrological modeling, drought forecasting, and groundwater recharge management.

Session 11 Recent Applications of Sediment Transport Modeling for California Dam Removals

Session Moderator: Adam Witt (Stantec)
Moderator Email: adam.witt@stantec.com

This past year saw the largest dam-removal project in historic completed in California, along with the advancement of several other major dam removal and restoration projects. Sediment transport modeling is a common approach to quantify the potential impacts and benefits of sediment removal, though

approaches to model application vary significantly based on the characteristics of the project. This talk will provide an overview of current sediment transport modeling approaches used to evaluate California dam removals of varying size. The talk will also include discussion of new sediment data from the Klamath Dam removal, and how this data compares to sediment modeling conducted prior to dam removal.

1. ***Dam Removal below a New Reservoir: Modeling Sediment Management Scenarios for the Pacheco Reservoir Expansion Project***

Presenter: Adam Witt (Stantec)
Presenter Email Address: adam.witt@stantec.com
Collaborators: Blair Greimann, Muneer Ahammad, Sagar Neupane (Stantec)
Permission to Post PDF of Presentation on CWEMF Website: NO

As part of the Pacheco Reservoir Expansion Project, Santa Clara Valley Water District (Valley Water) will be removing the existing North Fork Dam, a 100-foot tall and 600-foot long earth fill dam, and constructing a new 319 foot tall dam and 140,000 acre-foot reservoir upstream. The 1.8 miles of North Fork Pacheco Creek that had been inundated by the existing dam for the past 85 years will be restored to a natural channel to support South-Central California Coast Steelhead and other native riparian and aquatic species. An estimated 1,000,000 cubic yards of residual reservoir sediment is currently stored behind the existing dam that will need to be managed during construction of the new dam upstream. A sediment transport model was developed to evaluate sediment management scenarios during construction, ranging from full removal to no removal of reservoir sediment. The model was used to evaluate the rate of erosion of reservoir sediment in addition to downstream effects related to turbidity, channel erosion, and sediment aggradation. This talk will summarize data collection, model development, and modeling results being used to inform selection of a preferred sediment management alternative.

2. ***Dam to Estuary: Simulating Sediment Fate Following Dam Removal***

Presenter: Chris Lyle (Stillwater Sciences)
Presenter Email Address: clyle@stillwatersci.com
Collaborators: Joel Monschke & Christian Braudrick (Stillwater Sciences)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Predicting sediment transport following dam removal remains a complex challenge that requires careful model setup, evaluation of a range of hydrologic and sediment inputs, and exhaustive sensitivity testing. This presentation explores sediment transport modeling efforts underway to support the removal of Matilija and Rindge dams in Southern California. Leveraging USBR's Sedimentation & River Hydraulics two-dimensional flow hydraulic and mobile-bed sediment transport modeling (SRH2-D), several transport equations were evaluated to assess their applicability in predicting bedload and suspended load under varying hydrologic conditions. For model parameters with uncertain values, sensitivity analyses including variation in timesteps, transport coefficients, viscosity, sediment supply and numerical stability provided insight into model performance and predictive uncertainty. In addition to general sediment transport dynamics, the modeling results also informed infrastructure improvement recommendations, including potential modifications to channel geometry and downstream structures to enhance sediment conveyance and minimize impacts from deposition. This presentation will discuss key findings, model limitations, and how insights from these projects may refine modeling approaches for future projects elsewhere.

3. Klamath River Sediment Loads During and Following Dam Removal

Presenter: Scott Wright (cbec)
Presenter Email Address: s.wright@cbecoeng.com
Collaborator: Caitlin Boise (Resource Environmental Solutions)
Permission to Post PDF of Presentation on CWEMF Website: NO

The Klamath River Renewal Project includes the removal of four hydroelectric dams and associated facilities on the Klamath River in southern Oregon and northern California and subsequent restoration of formerly inundated reservoir footprints. In 2024, the reservoirs were drawn down and the dams were removed, resulting in the erosion and transport of sediment deposits from within the former reservoir footprints. The Klamath River Renewal Corporation and its restoration contractor Resource Environmental Solutions were responsible for implementing a series of monitoring and reporting actions before, during, and after the reservoir drawdown and dam removal. A regulatory requirement of the project was the establishment of a monitoring network prior to dam removal to measure various water quality constituents in the river reaches downstream from the dams through the project lifecycle. This network included real-time turbidity monitoring and suspended-sediment sampling at established gages from near Upper Klamath Lake, through the former hydroelectric/reservoir reach, and downstream to the Klamath River estuary. This presentation will review the results from this monitoring network, focusing on calculated continuous records of suspended-sediment concentrations and loads, as well as how sediment transport varied during reservoir drawdown, during dam removal construction activities, and following complete removal.

4. Making Change less Scary: Predicted and Observed Response from Klamath Dam Removals

Presenter: Blair Greimann (Stantec)
Presenter Email Address: blair.greimann@stantec.com
Permission to Post PDF of Presentation on CWEMF Website: No

One of the largest costs of dam removal is often the management of the sediment stored behind the dam. These costs can be greatly reduced by allowing the river to naturally erode the lake sediment; however, a major hinderance to utilizing this technique is the uncertainty of these sediment processes. In the Klamath River dams' case, the natural flow of the river and tributaries eroded the reservoir sediment and transported it downstream. This alternative was chosen because it was by far the least expensive management strategy and the impacts were considered acceptable by permitting agencies. To obtain agency and stakeholder buy-in, it was necessary to predict impacts related to the erosion and release of the reservoir sediment. The sediment transport models SRH-1D and SRH-2D, developed at Bureau of Reclamation, were used to predict the response from Klamath Dam Removal. The numerical models included estimates of reservoir erosion, downstream sediment concentrations and downstream deposition. With the removal of the dams in 2024, the modeled predictions of the sedimentation impact can now be compared to actual river response after dam removal and this is a unique opportunity to learn how to use numerical modeling to inform project design, project impacts, and adaptive management for dam removal. By comparing predicted response to actual river response, we can build confidence in the predictions of future dam removal projects and improve the planning of future dam removals throughout the nation.

Session 13: Themes in CalSim Development
Session Moderator: Zachary Roy (DWR)
Moderator Email: Zachary.Roy@water.ca.gov

CalSim and its associated tools continue to evolve to meet increasingly complex water management challenges and questions. This session highlights a variety of recent enhancements to the CalSim toolbox. Rather than focusing on specific projects, reports, or studies, attendees will gain insight into the broad vision on the future of CalSim development.

1. Artificial Neural Networks in CalSim
Presenters: Malinda Wimalaratne (DWR)
Presenters Email Addresses: malinda.wimalaratne@water.ca.gov
Collaborators: Hamed Zamanisabzi, Zachary Roy, Yiwei Cheng, Nimal Jayasundara, Nazrul Islam, Nicky Sandhu (DWR); Paul Hutton (Tetra Tech)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Artificial Neural Networks (ANNs) continue to play a critical role in enhancing the predictive capabilities and runtime efficiency of CalSim3. Ongoing work is focused on training robust models which respond well to uncertainty in future climate conditions, and potential future system operations. Presenters will highlight advancements in training, new data sources, and methods to boost model resilience. Attendees will gain insight into the future of ANNs in CalSim and the collaborative efforts underway to ensure the model adapts to evolving environmental and regulatory needs.

2. The CalSim Solvers

Presenter: Hamed Zamanisabzi (DWR)
Presenters Email Addresses: hamed.zamanisabzi@water.ca.gov
Collaborators: Malinda Wimalaratne, Zachary Roy, Yiwei Cheng, Nimal Jayasundara, Nazrul Islam, Nicky Sandhu (DWR); Paul Hutton (Tetra Tech)
Permission to Post pdf of Presentation on CWEMF Website: Yes

WRIMS currently supports multiple Mixed-Integer Programming (MIP) solver engines, and ongoing efforts are focused on expanding this support to include a broader range of solvers. This expansion is crucial for maintaining the accuracy, performance, and flexibility of CalSim as a tool for water resources planning. Furthermore, the integration of additional solvers enhances transparency in the results of CalSim simulations, providing stakeholders with greater insight into model behavior and outcomes. This session will give an overview of the work done to support additional solvers in WRIMS.

3. Plans for the Future of WRIMS

Presenter: Yiwei Cheng (DWR)
Presenters Email Addresses: yiwei.cheng@water.ca.gov
Collaborators: Hamed Zamanisabzi, Malinda Wimalaratne, Zachary Roy, Hao Xie, Nazrul Islam, Nicky Sandhu (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

WRIMS has long been a critical tool for water resources modeling in California, supporting the CalSim model to evaluate water system operations and management strategies. This session will preview WRIMS 3 development plans, which aim to enhance the transparency, maintainability, and modularity of WRIMS. Attendees will learn about the planned improvements and see how WRIMS 3 will continue to support a collaborative and sustainable approach to managing California's water resources.

4. CalSim Results Processing & Communication

Presenter: Raymond Hoang
Presenter Email Address: raymond.hoang@water.ca.gov
Collaborators: Hamed Zamanisabzi, Malinda Wimalaratne, Yiwei Cheng, Zachary Roy, Nazrul Islam
Permission to Post pdf of Presentation on CWEMF Website: Yes

This session will present strategies for visualizing CalSim 3 model results, with a focus on improving the clarity, accessibility, and utility of model outputs for diverse stakeholder audiences. Topics will include data architecture, processing workflows, and visualization techniques, with emphasis on the development and deployment of the Results Console (ReCon), an interactive, web-based dashboard that supports exploration of CalSim 3 results. The session will also provide a retrospective of historical visualization methods, evaluating their effectiveness relative to modeling objectives, data complexity, and project constraints.

Session 14: Update on DWR's Basin Characterization Program

Session Moderator: Mesut Cayar (Woodard & Curran)
Moderator Email: mcayar@woodardcurran.com

California Department of Water Resources (DWR has a long history of studying and characterizing California's groundwater aquifers as a part of California's Groundwater (Bulletin 118). The California's Groundwater Basin Characterization Program provides the latest data and information about California's groundwater basins and data analyses to help local communities better understand their aquifer systems and support local and statewide groundwater management and the implementation of the Sustainable Groundwater Management Act (SGMA). To support data analyses, California's Groundwater Basin Characterization Program will develop new tools and process documents to support the integration and analysis of a wide range of datasets to create maps and models that support groundwater management decisions. All tools and process documents will be made publicly available on the California Natural Resource Agency Open Data Portal and will be updated as revisions to tools and process documents are made. This session will provide an update DWR's Basin Characterization Program. The session will showcase activities that are being conducted as part of the program such as collection, analysis, and sharing of various datasets, development of tools, and Aquifer Recharge Potential (ARP) analysis.

1. An Update on DWR's Basin Characterization Program

Presenter(s): Katherine Dlubac & Steven Springhorn (DWR)
Presenter(s) Email Address(es): Katherine.dlubac@water.ca.gov; Steven.Springhorn@water.ca.gov
Collaborators: Benjamin Brezing & Craig Altare (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

DWR's Basin Characterization Program builds off DWR's historical role in characterizing groundwater basins as a part of California's Groundwater (formerly B-118). Under the Basin Characterization Program, DWR will conduct a series of Groundwater Evaluations at various scales to address SGMA implementation initiatives and fill data gaps. Statewide Investigations include the recently completed Statewide Airborne Electromagnetic (AEM) Surveys, which provided an advanced geophysical dataset across the state's priority basins and improves the understanding of large-scale aquifer structure. Local and Regional Investigations will focus on local SGMA implementation initiatives, like groundwater recharge, surface water groundwater interaction, subsidence, vulnerable domestic wells, disadvantaged communities, seawater intrusion, base of fresh water, etc. Investigations will include the collection of new data and digitization of existing data to create state-stewarded maps and models that describe the distribution of aquifer materials, aquifer structure, and recharge pathways. To develop the maps and models, new tools, analyses, and process documents will be created that integrate and analyze geologic, geophysical, and hydrogeologic datasets.

2. ***Transforming resistivity data to lithology for airborne electromagnetic (AEM) surveys***

Presenter: Javier Peralta (Ramboll)
Presenter Email Address: japeralta@ramboll.com
Collaborators: Timothy Parker, Paul Thorn, Mikkel Toftdal & Jeppe Schjerning (Ramboll), Katherine Dlubac, Steven Springhorn & Benjamin Brezing (DWR), David Shimabukuro (Eclogite)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Airborne electromagnetic (AEM) surveys provide a measurement of the electrical resistivity of the different geological strata up to 300 meters in depth. Given that, in general terms, resistivity decreases as clay content increases, these surveys provide information on the distribution of coarse-grained and fined-grained materials in the subsurface as well as potential areas with elevated groundwater salinity. This is useful in mapping out geometry and geologic properties of the underlying aquifer systems, the extent of seawater intrusion and brackish groundwater. California's Department of Water Resources conducted a state-wide AEM survey, collecting over 25,000 km of resistivity data in the state's high and medium priority groundwater basins. As part of this project, a resistivity to lithology transform method, specifically developed to handle large AEM datasets, was used. This method combined the detailed high-quality well lithologic data with information on the spatial heterogeneity from the resistivity to provide an interpretation of lithology. All well lithology information within 800 meters of the AEM data was collected and digitized. To ensure a robust transform, it was essential to confirm that well placement was within 50 meters of the registered coordinates. The lithology data descriptions were then aggregated into either coarse (sand or gravel) or fine (clay and silt). Computer-based calculations using an iterative inversion algorithm were then preformed, numerically comparing the resistivity with the simplified (binary) well lithology log data from the nearby wells. This produced a model of the coarse fraction thickness consistent with the lithology log coarse fraction in 2D sections along the AEM flight lines. However, since resistivity is also influenced by salinity, the lithology transform is limited to areas where groundwater salinity is under 3,000 mg/l. The coarse fraction calculated from the AEM survey data has provided valuable

information to better understand the spatial distribution of coarse and fine sediments in aquifer. The results have been used in the basin characterization efforts, including identifying potential recharge areas, interconnectivity of aquifers and thickness and extent of confining clay layers. This technique is also being used on surfaced based electromagnetic techniques, including tTEM, showing that the transform can also be done on smaller scale datasets, as long as there is well lithology information close to the collected data.

3. Advancing Hydrostratigraphic Model (HSM) and Groundwater Numerical Model Development with AEM and Hydrogeologic Data

Presenter(s): Vivek Bedekar (SSP&A) & Sercan Ceyhan (Woodard & Curran)
Presenter(s) Email Address(es): vivekb@sspa.com; sceyhan@woodardcurran.com
Collaborators: Jack Baer, Nicole Jacobsen, Tori Ward, Mesut Cayar & Saquib Najmus (Woodard & Curran), Matt Tonkin, Michael Ou & Leland Scantlebury (SSP&A); Katherine Dlubac & Steven Springhorn (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

California DWR has embarked on a multi-year program to characterize the State's groundwater basins and support water resource management, driven by SGMA. Central to this effort are wide-ranging data collection and digitization activities, including the acquisition of AEM survey data and the development of a freeware basin characterization and modeling toolset. The toolset – Data2HSM, Data2Texture, and Texture2Par - facilitates the processing, integration, and codification of disparate data types for water resource planning and modeling. These tools can function independently, depending on the user's end goals, or work together to generate 3D hydrostratigraphic models (HSMs) or numerical models. Data2HSM is a suite of three methods that utilize machine learning algorithms to process AEM and other hydrogeologic data, streamlining the creation of HSMs. The Gaussian Mixture Model clusters hydrostratigraphic units from AEM data, Smart Interpretation automatically interprets geologic surfaces from user-selected training points, and GeoPDNN models stratigraphic surfaces using point-based datasets. Data2Texture is an advanced spatial data interpolation tool for estimating the distribution of sediment textures using AEM and boring log data, enabling the development of 3D texture models.
Texture2Par is a groundwater model pre-processor and parameterization utility developed to work with IWFM and MODFLOW codes. Texture2Par takes the interpolated, gridded texture data from Data2Texture and estimates aquifer and aquitard hydraulic parameters (hydraulic conductivity, specific yield, specific storage) for groundwater models or other applications. This presentation shares progress updates on the toolset and seeks input on development directions to ensure the final toolset offers the most beneficial capabilities to the groundwater community.

4. Aquifer Recharge Potential Analyses: Development and Application

Presenter(s): Mesut Cayar (Woodard & Curran)
Presenter(s) Email Address(es): mcayar@woodardcurran.com
Collaborators: Liz DaBramo, Emily Honn, Nicole Jacobsen, Jack Baer, Adrien Camille, Kyle Nordquist & James Blanke (Woodard & Curran); Katherine Dlubac & Steven Springhorn (DWR): Vivek Bedekar & Michael Ou (SSP&A); Paul Thorn (Ramboll)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Aquifer Recharge Potential (ARP) analyses represent a significant advancement in identifying favorable locations for managed aquifer recharge. This approach, implemented across multiple local investigation areas, focuses on subsurface texture and flow paths. It dives deep into underground, natural infrastructure for recharge, supplementing other recharge suitability indices that consider anthropogenic

factors such as land use and water conveyance. The ARP maps, developed as part of the Department of Water Resources' Basin Characterization Program, integrate a three-dimensional subsurface texture model that co-kriges coarse fraction data from boring logs and Airborne Electromagnetic (AEM) surveys. This model reveals interconnected coarse bodies and flow paths, average sediment coarseness by aquifer depth, and depth to impeding clay layers. In addition to the texture model, the ARP analysis incorporates datasets for near-surface soil percolation and depth to water. Each factor is scored and weighted based on their importance to recharge. The maps cater to various recharge methods, including on-farm recharge, recharge basins, and dry wells, and target different aquifer depths and management objectives. The resulting ARP maps highlight areas with relatively high infiltration rates and significant water storage potential, supporting local water managers in their recharge investigations. This presentation will demonstrate the development, application, and lessons learned from ARP analyses. It will illustrate how ARP maps can serve as a valuable tool for water managers, supporting them in making informed decisions regarding recharge opportunities.

Session 15: Atmospheric Rivers and Water Resources in California: Challenges and Opportunities

Moderator: Luciana Kindl Da Cunha (WEST)
Moderator Email: lcunha@westconsultants.com

Atmospheric rivers play a crucial role in California's water cycle, delivering much of the state's annual precipitation. While these weather phenomena are vital for replenishing water supplies, they also pose significant challenges, including flooding, infrastructure strain, and water management uncertainties. As climate change intensifies, the frequency and intensity of atmospheric rivers are also changed, leading to both prolonged droughts and catastrophic storms. In a scary world where the future does not resemble the past, the community is coming together to create opportunities that will enhance the way we manage our water resources. This workshop will explore the latest research on atmospheric rivers, their evolving patterns due to climate change, and the implications for California's water resources. We will also discuss some of the opportunities that are being implemented to make the best use of available resources.

1. Atmospheric River Role for California Water Resources

Presenter: Mike Dettinger (CW3E)
Presenter Email: **mddettinger@gmail.com**
Permission for CWEMF to post pdf of presentation: Yes

California's largest storms are generally fueled by landfalling atmospheric rivers (ARs), which are long, narrow, and ever-migrating corridors of strong horizontal water vapor transport in the first km or so above the sea surface, that comprise >90% of all poleward water-vapor transport across the latitude band that we live in (despite the overall narrowness of the "rivers"). When ARs from across the North Pacific arrive in California, the extremes of precipitation that the largest ARs drop as they interact with California's mountains are intense enough, and can be prolonged enough, so that they play important roles in flooding, water resources, snow packs, levee breaks, landslides and other geomorphological changes, beneficial and problem floodplain inundations, estuarine salinities, groundwater recharge, wildfire risks, and other resource and ecological issues across the State. Thus the effects of ARs range from modest to large and from beneficial to hazardous. They are very important and natural parts of the State's climate, landscapes, social systems, and ecosystems, and are projected to become even more important and

extreme as the climate changes. This talk will provide a quick survey of characteristics of ARs and of the benefits and hazards they bring to California.

2. ***Future Changes in Atmospheric River Sequences over California***

Presenter: Christopher Castellano (UCSD)
Presenter Email: c1castellano@ucsd.edu
Collaborators: Julie Kalansky, Daniel Cayan, Rosa Luna–Niño, Alexander Gershunov, David Pierce (UCSD), Bin Guan (UCLA)
Permission for CWEMF to post pdf of presentation: Yes

Periods of enhanced atmospheric river (AR) activity, sometimes referred to as AR sequences or AR families, often result in extreme precipitation, flooding, and landslides, particularly in areas of complex topography such as the western United States. When ARs make landfall in rapid succession, these compound events can exacerbate hazards and their impacts on ecosystems, infrastructure, and human safety. AR sequences such as the nine ARs that made landfall over California between late Dec 2022 and mid-January 2023 can also play a vital role in replenishing reservoirs, building seasonal snowpack, and eradicating long-term drought. This research investigates projected changes in AR sequences and associated hazards over the western United States during the 21st century. An AR sequence is defined as a continuous period during which the 5-day running mean integrated water vapor transport (IVT) exceeds the 75th percentile of historical daily IVT and the maximum 5-day running mean IVT is at least 250 kg m^{-1} s^{-1}, a common threshold for detecting ARs. Individual ARs within each sequence are identified at coastal locations based on minimum IVT (250 kg m^{-1} s^{-1}), precipitable water (15 mm), and length (1500 km) criteria. Analyses are carried out for the October–April wet season using a subset of CMIP6 global climate models whose historical simulations exhibit realistic spatiotemporal variability, frequency, and intensity of landfalling ARs as compared to ERA5 reanalysis. Results will illustrate how projected changes in the characteristics of AR sequences may differ between northern, central, and southern California.

3. The Limits of the Deluge: How Extreme Can Atmospheric Rivers Get?

Presenter: Matthew Koszuta (WEST)
Presenter Email Address: mkoszuta@westconsultants.com
Collaborators: Luciana Cunha, Tony Janicek, Keith Mills, Jason Cordera, Caileen Yu (WEST)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Probable Maximum Precipitation (PMP) has long been a critical design factor for high-risk infrastructure, including dams and nuclear reactors. Traditionally, PMP is defined as 'the theoretically greatest depth of precipitation for a given duration that is physically possible…,' though a revised definition has recently been proposed. WEST is currently updating atmospheric river (AR)-based PMP estimates—both current and projected—for the state of Oregon using numerical weather prediction models. This project explores the extent to which extreme atmospheric rivers can intensify, shedding light on their potential future impacts. More extreme ARs have significant implications for California's water resources, including flooding, dam safety risks, drought-flood whiplash, snowpack instability and water quality issues.

4. Enhanced Water Management through Forecast Informed Reservoir Operations (FIRO)

Presenter: Ben Tustison (MBK Engineers)
Presenter Email Address: tustison@mbkengineers.com
Permission to Post PDF of Presentation on CWEMF Website: Yes

Since the completion of the Joint Federal Project (JFP) at Folsom Dam, an auxiliary spillway designed to enhance operational flexibility and capacity, Forecast Informed Reservoir Operations (FIRO) has revolutionized the management of this critical infrastructure. By integrating advanced weather forecasting into reservoir operations, FIRO enables more adaptive and efficient water management. This data-driven approach is not only optimizing the performance of existing dams but also strengthening the case for investments in new infrastructure by demonstrating the value of predictive operations. This presentation examines how FIRO has enhanced Folsom Dam's multiple functions, including flood control, environmental stewardship, recreation, and water supply. It will explore the engineering and institutional challenges encountered during the JFP's implementation and highlight FIRO's role in shaping plans for the dam's 3.5-foot raise. Using Folsom as a case study, this discussion will provide key insights into the broader challenges and opportunities that FIRO presents for water managers, engineers, and policymakers.

5. Opportunities for California Water Resources

Presenter: David Curtis (WEST)
Presenter Email Address: dcurtis@westconsultants.com
Permission to Post PDF of Presentation on CWEMF Website: Yes

The speaker will close the session with a discussion on future opportunities for California's water resources. He will explore innovative approaches to data collection, forecasting, and modeling that can enhance the state's resilience to hydrological extremes and improve water resource management.

Session 16: Machine Learning for Water and Environmental Modeling
Moderator: Kevin He (DWR)
Moderator Email: Kevin.He@water.ca.gov

Recent advancements in machine learning (ML) are providing transformative possibilities for water and environmental modeling, redefining how critical challenges in water resources management are addressed. This session features studies that illustrate the power of ML to enhance streamflow forecasting across various temporal scales, accurately predict environmental risks such as harmful algal blooms, and establish best practices for ML model development and ML-driven solutions. These applications showcase not only the versatility of ML but also its ability to complement and to improve upon traditional methods. Together, they emphasize the expanding role of ML in delivering innovative, adaptive, and efficient solutions for managing complex water resources and environmental systems.

1. Machine Learning Protocols for Water and Environmental Modeling

Presenter: Kevin He (DWR)
Presenter Email: Kevin.He@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

As models play an increasingly important role in water management, there is growing scrutiny over their development and use. The water community widely acknowledges the need for standardized modeling protocols. Machine Learning (ML) techniques have advanced significantly in recent years, driving their increased application in water management. The Modeling Support Office (MSO) of DWR has been exploring and utilizing ML methods for water and environmental modeling (WEM) since the early 1990s. This presentation builds on MSO's extensive experience to propose protocols for developing and applying ML models specifically for WEM efforts.

2. Machine Learning-Based Harmful Algal Blooms (HABs) Modeling in the Delta

Presenter: Gourab Saha (DWR)
Presenter Email: Gourab.Saha@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

Harmful Algal Blooms (HABs) are an increasing concern in the Delta, posing risks to water quality, ecosystems, and public health. To address this issue, we developed machine learning (ML) models using grab-sampling data to predict the risk of HAB occurrences. Multiple ML approaches were trained and evaluated to classify risk levels, focusing on distinguishing a range from low-risk to high-risk conditions. Results indicate that these ML models demonstrate strong potential for accurate HAB risk prediction, offering a valuable tool for early risk assessment. By enabling water managers to proactively monitor and respond to HAB threats, these models could significantly enhance the efficiency of HAB management and mitigation efforts in the Delta.

3. Emulating Traditional Statistical Models in Seasonal Streamflow Forecasting via Machine Learning

Presenter: Peyman Namadi (DWR)
Presenter Email: peyman.hosseinzadehnamadi@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

Statistical models have long served as the foundation for seasonal streamflow forecasting in water supply watersheds in the Central Valley, supporting critical operational decisions for major water projects. While these models have proven reliable, they often require statistical assumptions and manual calibration. This study proposes a deep learning approach using Long Short-Term Memory (LSTM) networks to emulate and potentially enhance these traditional forecasting methods. By leveraging the same historical hydrometeorological inputs used in conventional models - including precipitation, temperature, vapor pressure deficit, and streamflow measurements from 1922-2021 – this study aims to develop a more automated and adaptable forecasting framework. This work represents an exploration of how modern machine learning techniques can complement and advance established hydrological forecasting methods in California.

4. Improving Streamflow Simulation in Central Valley Watersheds Using Deep Learning

Presenters: Yu-Chieh Jay Chao (UCD) and Kevin He (DWR)
Presenter Email: ycjchao@ucdavis.edu ; kevin.he@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

Streamflow is a critical hydroclimatic variable essential to water system performance, yet its prediction often varies significantly across hydrologic process-based models (PBMs), posing challenges for consistent application in water resources planning. Recent advancements in machine learning, particularly deep learning, offer transformative potential. This study employs LSTM and its variants to simulate daily streamflow in 14 watersheds across the Central Valley. The results are highly promising, with LSTM models outperforming PBMs across most study metrics. These findings highlight the significant potential of deep learning to revolutionize streamflow simulation and advance water resources planning practices.

5. Towards Generalization in CalSim Surrogates for Drought, Sea Level and Landscape Change

Presenters: Eli Ateljevich (DWR)
Presenter Email: eli.ateljevich@water.ca.gov
Collaborators: Lily Tomkovic (DWR), Can Ruso (UC Berkeley)
Permission for CWEMF to post pdf of presentation: Yes

The use of artificial neural networds (ANNs) as surrogates for salinity dynamics from DSM2 has a long and successful history in statewide modeling. Recently, more focus has been cast on restoration and inundation, sea level rise and episodic severe drought, all of which test the ability of DSM2 and the ANNs. As part of a project with the Delta Science Program introduced at the last CWEMF meeting, DWR and RMA have worked to revise the training methods, datasets, architecture and implementation in CalSim. The methods include novel Design of Experiments for providing richer training data when run time is expensive, transfer learning for stepping from DSM2 to multidimensional models and then again to sea level or restoration conditions, new architectures for the ANN that reduce overfit and a new TensorFlow Java interface that allows models to be be used in CalSim with small modifications in the way constraints are written. The focus of this talk is on the ANN training process, architecture and result, but some CalSim implications will be discussed.

Session 17: Modeling of CalSim 3 Inputs

Session Moderator: Mohammad Hasan (DWR)
Moderator Email: Mohammad.Hasan@water.ca.gov

1. Advancement in Modeling Reference Evapotranspiration for CalSim3 Model

Presenter: Mohammad Hasan (DWR) and Bridget Childs (Stantec)
Presenter Email Addresses: mohammad.hasan@water.ca.gov; bridget.childs@stantec.com
Collaborators: ZhiQiang Richard Chen [DWR]; Samuel Price [Dynamic Geo-spatial Solutions]; Andy Draper [Stantec]; James Polsinelli, Jianzhong (Jay) Wang, Ruian Dhong [DWR]
Permission to Post pdf of Presentation on CWEMF Website: Yes

Accurate estimation of reference evapotranspiration (ETo) is crucial for hydrological modeling in California's Central Valley. This presentation introduces a new spatially distributed ETo dataset, covering the entire state at a 4x4 km resolution (PRISM grid) and monthly time intervals from 1921 to 2021. The dataset is derived using the Hargreaves-Samani (H-S) equation, and PRISM's daily maximum (Tmax) and daily minimum (Tmin) temperature data. To enhance accuracy, the H-S ETo was calibrated against the spatially gridded Penman-Monteith ETo from the Spatial CIMIS dataset. This calibration employs a streamlined, one-factor approach, replacing the previous station-based, two-factor method used in CalSim3 for Crop ET calculations. Specifically, twelve monthly calibration factors are generated for each PRISM cell using ratios of monthly Spatial CIMIS ETo and monthly H-S ETo, which are averaged over the calibration period of 2004-2021. In addition, we have applied the resulting ETo dataset to develop time series for CalSim3 model's water budget areas (WBAs) by spatially averaging the grid cell ETo values within each WBA. This efficient methodology enhances consistency, reduces complexity, and delivers more reliable ETo inputs for CalSim3 model, leading to improved agricultural water demand estimations.

2. CalSim3 Upper San Joaquin Model

Presenter: Mina Shahed Behrouz (Stantec)
Presenter Email Addresses: Mina.ShahedBehrouz@stantec.com
Collaborators: Andy Draper [Stantec], Ryan Lucas & Nancy Parker (USBR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

This presentation details the development of a monthly time-step reservoir operations CalSim3 module for the Upper San Joaquin River watershed. The Upper San Joaquin River Basin (HUC 18040006) is the farthest southeast watershed of the larger San Joaquin Valley watershed. The watershed drains approximately 1,600 square miles of the western slopes of the Sierra Nevada, with primary tributaries including the North, Middle, and South Fork of the San Joaquin River, Big Creek, Stevenson Creek, and Willow Creek. The Upper San Joaquin River has been extensively developed for hydropower generation by both Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE). This new model allows a planning level simulation of the upper watershed to be integrated with the existing CalSim 3 model representation of the larger San Joaquin Valley watershed. Model development includes assembly of historical unimpaired monthly inflows that are computed using historical streamflow records, reservoir storage data, and evaporation estimates from the U.S. Geological Survey (USGS) and from water agencies managing facilities in the watershed. These data are integrated over time at various locations within the

watershed using mass balance equations where possible and using statistical methods where historical data are not available. A 100-year monthly hydrologic data set has been developed for the period from October 1921 through September 2021. Simulation rules were developed to characterize operations of water control facilities within the watershed. Model calibration and validation was performed by comparing simulated results with recent historical data for water years (WY) 2002-2021. Finally, simulations using current physical facilities, regulatory requirements, and operational criteria were developed to characterize operations under existing level of development conditions.

3. VIC-perturbed CalSim3 Rim Inflows for Climate Change Scenarios

Presenter(s): Ruian Dong & Jianzhong (Jay) Wang [DWR]
Presenter(s) Email Address(es): ruian.dong@water.ca.gov, Jianzhong.Wang@water.ca.gov
Collaborators: James Polsinelli, Mohammad Hasan, ZhiQiang Richard Chen [DWR]
Permission to Post pdf of Presentation on CWEMF Website: Yes

Stream flows from upper Sierra Nevada watersheds (rim inflows) are a critical component of California's water supply. For 2023 DCR studies for the 2043 Climate Change Conditions, rim inflows were estimated based on a perturbation approach which perturbs more than 200 historical inflow traces using monthly and annual ratios with regional adjustments, calculated from the VIC hydrologic model. Ratios are derived by comparing VIC outputs under a baseline historical conditions and future climate scenarios for 50th percentile, 75th percentile, and 95th percentile level-of-concerns which correspond to projections of 1.5°C, 1.7°C, and 1.8°C warming. In this presentation, we will show the analysis results of QA/QC of the perturbed rim inflow for consistent climate signals among watersheds, how the extent of actual evapotranspiration (AET) varies across regions, and how watershed-specific characteristics influence rim inflow changes under the same climate projection scenario.

4. CalSim3 Historical Hydrology Model

Presenters: Bridget Childs [Stantec] and Ryan Lucas (USBR)
Presenters Email Addresses: bridget.childs@stantec.com; rlucas@usbr.gov
Collaborators: Andy Draper [Stantec], Nancy Parker [USBR], James Polsinelli, ZhiQiang Richard Chen [DWR]
Permission to Post pdf of Presentation on CWEMF Website: Yes

The WRIMS-based CalSim3 Historical Hydrology Model was developed to improve CalSim3's representation of hydrology, utilizing historical data to assess model error. The CalSim3 Historical Hydrology Model contains little operational logic, routing historical inflows from the rim watersheds through the CalSim3 model network to the Delta. Reservoir storage and stream diversions are constrained to historical observed values while stream-groundwater interaction is dynamically determined by the groundwater DLL. Hydrologic parameters are consistent with the CalSim3 planning study model. Comparison of simulated flows to historical gauge data at key gauge locations along the mainstem of the major rivers are used to quantify the model error and develop time series of bias corrections for these key locations. This model addresses long-recognized weaknesses of the CalSim3 model hydrology: Firstly, the development of stream accretions known as closure terms (or bias corrections) have previously relied on pre-processed simulations from two different models creating inconsistent set of assumptions and data.

Development of this model removes this inconsistency by pairing historical data with dynamic groundwater DLL usage. Secondly, the performance of the C2VSim-based groundwater DLL when coupled with CalSim3 has not been calibrated. Development of this model allows future opportunity to automate calibration of the CalSim3 hydrology and groundwater DLL to improve model reliability.

Session 18: Integrating Forecast-Informed Strategies and Multi-Benefit Approaches for Sustainable Flood-MAR Operations
Session Moderator: Ali Taghavi (Woodard & Curran)
Moderator Email: ataghavi@woodardcurran.com

The San Joaquin Flood-MAR Watershed Studies are a state-of-the-art watershed investigation of Flood-MAR's potential to mitigate flood risks, improve water supply reliability, enhance ecosystem health, and advance sustainable water resources management in California. This session will include an in-depth discussion of the novel design elements included in the integrated toolset – their role in crafting a multi-sector solution and associated implementation challenges, considerations, and opportunities.
This session features five presentations which will explore innovative strategies and tools advancing Flood-MAR operations, highlighting their ability to achieve multi-benefit outcomes. Key topics include integrating Forecast-Informed Reservoir Operations (FIRO) with MAR to improve flood flow management, recharge efficiency, and ecosystem water deliveries using synthetic ensemble forecasts. The session also features the use of data-driven tools, such as the Recharge Suitability Index (RSI) and Groundwater Recharge and Assessment Tool (GRAT), to strategically prioritize recharge areas and balance ecological and sustainability objectives. Case studies from Central Valley watersheds showcase the development of Flow-Through Basins (FTBs) and the application of habitat suitability and ecological flow frameworks to enhance biodiversity and water resource sustainability. Through these discussions, participants will gain actionable insights into leveraging advanced modeling tools, multi-benefit flow strategies, and targeted recharge initiatives to address critical challenges, including subsidence, equitable groundwater access, and climate resilience. This session offers practical pathways to integrate innovative solutions into watershed-scale water management plans, ensuring long-term sustainability and resilience.

1. FIRO-MAR Operations with 1-to-7-day Synthetic Ensemble Forecast

Presenter: Alex Vdovichenko (DWR)
Presenter Email Address: Aleksander.Vdovichenko@water.ca.gov
Collaborators: Wyatt Arnold, David Arrate, Karandev Singh (DWR); Gerardo Carrillo (MBK), Joan Klipsch (USACE)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The FIRO-MAR operations were developed as part of the Integrated Forecast-Informed Resources Management (I-FIRM) strategy for seven tributary reservoirs of the San Joaquin Basin Flood-MAR Watershed Studies to support benefits for the flood control, water supply, and ecosystem water management sectors. The I-FIRM strategy modifies reservoir operations and establishes a FIRO space to improve management of flood flows, increase applied recharge and establish an eco-pool account to enhance ecosystem management flows and deliveries using stored water in the FIRO space. The FIRO-MAR operations incorporate Ensemble Forecast Operation (EFO) using a 1-to-7-day synthetic ensemble forecast (n = 30 members), acknowledging forecast accuracy and uncertainty. The FIRO-MAR operations consist of two types of new reservoir releases: a conservation space pre-release and a FIRO space release. The FIRO space is sized based upon reservoir characteristics, including gross storage, flood control space, release capacity, and downstream channel capacity. Generally, the controlling factor is how quickly the FIRO space can be evacuated over a 5-day period

within downstream channel capacity constraints. The EFO is driven by a risk tolerance curve corresponding to non-exceedance levels of the calculated release. This presentation highlights the main components of operations that strategically combine FIRO and MAR and demonstrates some of the flood control, water supply, and ecosystem benefits of the operations.

2. Balancing Recharge and Ecology: Optimizing Flood-MAR Strategies for Sustainable Water Management

Presenter: Taylor Spaulding (ESA)
Presenter Email Address: TSpaulding@esassoc.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

Flood-MAR operations, which divert high-flow water for aquifer recharge, can significantly influence ecological communities, both positively and negatively. To balance ecological health with recharge goals, it's essential to apply integrated water and resource management strategies. This presentation introduces a comprehensive method that illustrates Flood-MAR implementation by combining the California Environmental Flows Framework (CEFF), Forecast-Informed Reservoir Operations (FIRO), Ecological Floodplain Inundation Potential (EcoFIP), and habitat suitability models. Using five Central Valley watersheds as case studies, we demonstrate how this approach enhances recharge potential while minimizing ecological trade-offs, offering a practical path toward sustainable water management.

3. Developing Multi-Benefit Flow-Through Basins for Flood Risk Reduction, Groundwater Recharge, and Habitat Enhancement

Presenter: Daniel Siegel (Earthgenome)
Presenter Email Address: danial@earthgenome.org.org
Collaborators: Aysha Masell Earthgenome)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Flow-through basins (FTBs) offer an innovative solution for reducing flood risk, replenishing groundwater, and restoring ecosystems in smaller creek systems. These basins divert excess floodwaters into controlled areas, where water infiltrates to recharge aquifers while creating habitat for pollinators, riparian vegetation, and groundwater-dependent species. Using a data-driven process, five Central Valley watersheds were evaluated to identify optimal FTB sites based on flood dynamics, soil suitability, and ecological potential. FTBs not only mitigate flood risks but also enhance biodiversity and support agriculture through improved water management. This presentation showcases a scalable framework for integrating FTBs into watershed management plans to achieve sustainable, multi-benefit outcomes.

4. Improving Watershed-Scale Recharge: Tools, Strategies, and Multi-Sector Benefits

Presenter: Dominick Amador (Woodard & Curran)
Presenter Email Address: Damador@woodardcurran.com
Collaborators: Andres Diaz, Liz DaBramo, Emily Honn, Jack Baer, Ali Taghavi (Woodard & Curran)
Permission to Post pdf of Presentation on CWEMF Website: Yes

This presentation will explore the technical development and application of advanced modeling tools designed to optimize watershed-scale recharge in the San Joaquin Watershed FloodMAR Studies. Specifically, it will examine how the integration of recharge management areas (RMAs), the recharge suitability index

(RSI), and crop compatibility assessments, work together to target local management objectives and guide both direct and in-lieu recharge efforts. RMAs play a key role in prioritizing recharge by identifying critical areas where efforts can provide the greatest benefits. These include zones impacted by subsidence, disadvantaged communities (DACs), groundwater-dependent ecosystems (GDEs), and in-basin retention. The RSI further refines this approach by evaluating site-specific factors like soil permeability, hydrogeological conditions, and aquifer texture to determine preferred recharge locations. Finally, crop compatibility assessments evaluate the feasibility of recharge in an agricultural setting, ensuring that it aligns with local farming practices and crop water needs. This presentation will also discuss how these tools are further strengthened though stakeholder coordination, insights from local groundwater sustainability plans (GSPs), and integration with modeling platforms such as the Groundwater Recharge Assessment Tool (GRAT) and the Flood-MAR San Joaquin Groundwater-Surface Water Simulation Model (FMSJSim). By combining a suite of tools and resources, the San Joquin Watershed Study presents as comprehensive framework that aligns basin objectives with efficient water use and improves recharge management for long-term sustainability at both a local and regional scale.

Session 20: Trinity River: Entering a New Era of Flow and Temperature Management?

Moderator: Adam Witt (Stantec)
Moderator Email: adam.witt@stantec.com

1. Boundary conditions formulation for Trinity Lake, Lewiston Lake, and Trinity River, model application and performance of the available W2 and ResSim models

Presenter: Mike Deas (Watercourse Engineering)
Presenter Email Address: mike.deas@watercourseinc.com
Collaborators: Randi Field, Ryan Lucas (USBR); Ben Saenz (RMA)
Permission to Post PDF of Presentation on CWEMF Website: YES

Development of water temperature forecasting and planning models for the Trinity River system are a subset of the Water Temperature Modeling Platform (WTMP) developed by the U.S. Bureau of Reclamation to assist in managing water temperature in the Shasta-Trinity Division of the Central Valley Project (CVP). The Trinity Division is the second largest CVP component for the northern Sacramento Valley and includes Trinity Lake, Lewiston Lake, as well as Clear Creek Tunnel (diversion to Clear Creek) and Whiskeytown Lake on Clear Creek, a tributary of the Sacramento River. Releases from Lewiston Dam provide downstream flow in the Trinity River. The WTMP models include Trinity Lake, Lewiston Lake, and the Trinity River from Lewison Dam to the North Fork Trinity River. Developing, calibrating, and applying these models require the formulation of flow, temperature, and meteorological boundary conditions. Overall, data from 2000-2021 was considered in model development, with subsets of this period used for model calibration due to data limitations. Development of boundary conditions where data were unavailable included Trinity Lake inflows and inflow temperatures and temperatures for the tributaries to the Trinity River below Lewiston Dam. The long-term solution is expanded monitoring. In the interim the formulation and refinement of model boundary conditions is an ongoing activity.

2. *Modeling analysis of Humboldt County Contract Water releases into the Trinity River*

Presenter: Adam Witt (Stantec)
Presenter Email Address: adam.witt@stantec.com
Collaborators: Tom FitzHugh, Rafael Herrerra, Sarah Hamilton (Stantec); John Plumb, Nicholas Som, Russ Perry (USGS); Bill Pinniz (USFWS)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Humboldt County has developed a Water Management Plan that describes a range of proposed annual releases from Trinity Reservoir consistent with the 1959 water delivery contract between Humboldt County and the U.S. Bureau of Reclamation (Reclamation). The 1959 contract states that Reclamation shall release not less than an annual quantity of 50,000 acre-feet into the Trinity River for the beneficial use of Humboldt County and other downstream users (Contract Water). The Water Management Plan outlines how Contract Water should be released for the benefit of fisheries in the Trinity River and lower Klamath River, with the primary goal of expanding a harvestable surplus of Tribal, recreational, and commercial fisheries. This talk will describe a set of annual Contract Water release scenarios developed during five workshops conducted in 2022 and 2023 with interested parties including Humboldt County, state and federal resource agencies, tribal representatives, Reclamation, and the U.S. Department of the Interior Solicitor's office. A suite of modeling tools was used to assess Contract Water release scenarios, including CalSim II, HEC-5Q, RBM10, sediment transport models, Chinook Salmon habitat models, and the Stream Salmonid Simulator (S3). Results from modeling scenarios were used to develop a flow release proposal that was proposed to Reclamation for inclusion as an alternative in the Trinity River Division of the 2021 Reinitiation of Consultation on Long-Term Operation of the CVP and SWP.

3. *Method to Implement Natural Flow Regimes for Regulated Rivers In Constrained Management Contexts*

Presenter: Nicholas Som (USGS)
Presenter Email Address: Nicholas.Som@humboldt.edu
Permission to Post PDF of Presentation on CWEMF Website: Yes

Rivers and streams throughout the world have been dammed for flood control, irrigation, and water storage for centuries. In more recent decades, the effects of flow regulation on river and stream ecology such as water temperature alteration and disruption of geomorphic processes have gained more attention. Additionally, flow regulation reduces or eliminates synchronicity of regulated releases with changes in runoff and response of unregulated streams to precipitation events. We developed a real time management (RTM) tool, with an example from the Trinity River, California, that allows river managers to synchronize dam releases with naturally occurring runoff patterns, providing greater ecological benefits than traditional environmental flow techniques. Pre-dam correlation of the Trinity River with a local unimpaired river averaged 0.87, but declined to 0.18 in the last two decades under a flow restoration program. Modeled river flows using RTM increased correlation of the two rivers over the same two decades to 0.68, and provided a better match to the unimpaired monthly distribution of water volumes within each year. We also analyzed sediment transport over 12 years in the reach downstream of Lewiston Dam, and found that the river flows resulting from RTM would have transported a total of approximately 4,140 tons of suspended sediment versus 653 tons of suspended sediment under the current flow restoration program, with similar results for fine and coarse sediment. Using 5-day river forecasts and flood control thresholds, RTM is robust to concerns of infrastructure and human safety, while also staying

within annual water volume allocations. RTM provides multiple benefits to river ecology, substantially increasing river restoration effectiveness.

Session 22: Updates to DWR's C2VSim Fine Grid Model
Moderator: Craig Altare (DWR)
Moderator Email: craig.altare@water.ca.gov

This session will provide attendees with an overview of the latest updates to one of DWR's integrated groundwater and surface water modeling applications in the Central Valley. The California Central Valley Groundwater-Surface Water Simulation Model Fine Grid version (C2VSimFG) is developed by DWR and used by Groundwater Sustainability Agencies in the Central Valley to support their work in developing and implementing Groundwater Sustainability Plans. Talks in this session will go over recent work to extend and update input data for C2VSimFG. The session will also include a talk about a web application where users can view the results of C2VSimFG, including simulated groundwater levels and various water budget components. Additionally, information will be provided about the plans for future updates to the C2VSimFG and potential enhancements to the Integrated Water Flow Model (IWFM) code that may be of interest for sustainable groundwater management and planning.

1. Introduction to DWR's C2VSimFG Application – Purpose, Current Updates, Future Plans

Presenter: Craig Altare (DWR)
Presenter Email: craig.altare@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

The California Department of Water Resources (DWR) has developed and continues to enhance the Fine-Grid Version of the California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG). In compliance with the Groundwater Sustainability Plan Regulations, DWR is committed to equipping groundwater managers across the Central Valley with C2VSimFG as a tool for their planning efforts under the Sustainable Groundwater Management Act (SGMA). Since SGMA's enactment, DWR has released multiple versions and updates of C2VSimFG, with significant advancements and time-series extensions that enhance its functionality. This presentation will provide an overview of the evolution of C2VSimFG, its practical applications in SGMA planning within the Central Valley, the latest enhancements to the model, and insights into future updates and improvements planned for the coming years.

2. Land Surface Process Updates to C2VSimFG

Presenter: Lan Liang (DWR)
Presenter Email: lan.liang@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

The Fine-Grid Version of the California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG) has been updated to address some known issues and to extend the historical simulation period to 2021. As part of the update, the C2VSimFG land surface process was updated and calibrated to newly collected remote sensing and observed data. New datasets considered in the updated version of C2VSimFG include county land use data, statewide crop mapping, remotely sensed evapotranspiration data from ITRC and OpenET, PRISM and CIMIS climate data, and California Water Plan urban water use. These new data provide more systematic and realistic spatiotemporal distributions of precipitation, land use, ET, and urban water use in the model domain. Tile drains and no-pumping zones were implemented

in the Sacramento-San Joaquin Delta to better represent Delta conditions. Groundwater uptake for non-irrigated areas was added to improve the simulation of the interconnection between the root zone and groundwater. Land surface and root zone parameter adjustments, along with the new input data, helped to address issues of simulated groundwater heads above the land surface in earlier versions of C2VSimFG and helped to better represent the spatial and temporal trends of Central Valley water budgets, groundwater levels, pumping, and storage.

3. Surface Water Process Updates to C2VSimFG

Presenter: Guobiao Huang (DWR)
Presenter Email:
Permission to Post PDF of Presentation on CWEMF Website: Yes

The Fine-Grid Version of the California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG) has been updated to address some known issues and to extend the historical simulation period to 2021. As part of the update, the C2VSimFG surface water process was updated, the C2VSimFG surface water process was updated for streamflow, surface water diversions, and small watersheds. This presentation will discuss model updates on time series data extension for Water Years 2016 – 2021, recalibration of small watershed parameters, refinement and bug fixes for surface water deliveries and flood bypasses, and how these updates affect surface water and groundwater budgets.

4. C2VSimFG Web Application

Presenter(s): Thi Pham (DWR) and Thomas Heinzer (Michael Thomas Group)
Presenter(s) Email(s): thi.pham@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

The Fine-Grid Version of the California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG) Web Application is a visual tool to explore simulated model results of the latest version of C2VSimFG. The application is developed through a collaborative effort between the Department of Water Resources (DWR), the Michael Thomas Group, and Woodard & Curran. This interactive application allows local agencies and other interested parties, regardless of their modeling experience, to easily access and visualize C2VSimFG data and simulated results—without needing to run the complex, five-hour model themselves. The application can generate hydrographs, water budgets, and zonal budgets using the latest C2VSimFG dataset. The presentation will discuss the development challenges, the application's functionality, and planned future updates.

5. IWFM Solute Transport Module Development

Presenter: Uditha Bandara (DWR)
Presenter Email: uditha.bandara@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

A new solute transport module, based on the Lagrangian Parcel method, has been added to the Integrated Water Flow Model (IWFM) to enable the prediction of the long-term transport and fate of contaminants in groundwater aquifers. The solute transport model was initially developed independently from IWFM and verified against available analytical solutions and limited field data using velocity fields generated from the Fine-Grid Version of the California Central Valley Groundwater-Surface Water Simulation Model

(C2VSimFG) and MODFLOW. The IWFM simulated flow field is passed through memory to the transport module, which runs concurrently as part of a single IWFM model run. The capabilities of the solute transport module are demonstrated through simulations of hypothetical scenarios in the Central Valley. The addition of the solute transport module enables users to estimate the long-term water quality impacts resulting from the presence of contaminants, such as nitrates, and to evaluate the feasibility and long-term effects of Agricultural Management Aquifer Recharge projects. The solute transport model is now available as a module within IWFM for beta testing by interested users.

Session 23: Implementation of the Sites Project in CalSim 3
Moderator: Reed Thayer (Jacobs)
Moderator email: reed.thayer@jacobs.com

Over the past year and a half, there has been an effort to migrate the Sites Project water operations modeling from CalSim II to CalSim 3. Over the course of the session, the project team will discuss the rationale for the migration, the steps taken, some specific challenges and solutions, and lessons learned in implementing a new storage project into CalSim 3.

1. Overview of the Sites Project and Rationale for Migration to CalSim 3

Presenter: Angela Bezzone (MBK Engineers)
Presenter Email Address: bezzone@mbkengineers.com
Collaborator: Ali Forsythe (Sites Project Authority)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Sites Reservoir is a proposed 1.5 million acre-foot reservoir that would capture and store water during periods of high flow and release the water for California communities, farms, and environmental agencies to use during drier periods when it is needed. It is designed to be a climate-resilient, 21st Century water storage system. To support permitting, feasibility, and design, a comprehensive modeling effort has been conducted over the past decade, largely using CalSim II. To support the continued planning and design process, the Sites Project Authority is transitioning its water supply modeling into CalSim 3 which has recently been used in the 2021 Central Valley Project LTO and the 2021 and 2023 State Water Project Delivery Capability Reports. Through a dynamic regulatory and planning process, the Sites Project is focused on its mission to responsibly manage and deliver water, improve the environment, and provide flood control and recreational benefits.

2. Cartography meets Modeling: Implementing a Complex Offstream Reservoir in CalSim 3

Presenter: Reed Thayer (Jacobs)
Presenter Email Addresses: reed.thayer@jacobs.com
Collaborators: Rob Leaf (Jacobs), Tom FitzHugh (Stantec), Puneet Khatavkar (Stantec), Shankar Parvathinathan (MBK Engineers), Chad Whittington (Jacobs), Solmaz Rasoulzadeh (Jacobs), Luke Philbert (Jacobs)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Implementing the Sites Project, an offstream storage project with multiple beneficiary operations, required a collaborative effort in which many lessons were learned. While the Sites Project has been extensively modeled in CalSim II, the more complex structure of CalSim 3 provided both challenges and opportunities. Additionally, the model development occurred as the project and regulatory framework

were actively evolving. This presentation will discuss the core Sites Project module, steps that were taken in developing the infrastructure and operations, integration with existing facilities and projects, how performance was evaluated, and what we have learned so far.

3. Estimation of Daily Flows in CalSim 3 for the Sites Project

Presenter: Luke Philbert (Jacobs)
Presenter Email Addresses: luke.philbert@jacobs.com
Collaborators: Chad Whittington (Jacobs), Rob Leaf (Jacobs), Tom FitzHugh (Stantec)
Permission to Post pdf of Presentation on CWEMF Website: Yes

CalSim 3 is a California water resources model that simulates flows and operations on a monthly time-step. Recently, however, daily flow estimates were integrated into CalSim 3 for the evaluation of the Sites Reservoir Project. One purpose of this integration was to allow for more accurate representation of Sites operational rules, many of which consist of sub-monthly requirements. Additionally, daily flow calculations along the Sacramento River between Bend Bridge and the Sacramento Weir allow for more realistic representation of weir spills, which often include significant fluctuations on a sub-monthly timescale. This presentation provides an overview of the data development and updates incorporated into CalSim 3 to include representation of daily variability in river flows, weir spills, and Sites Project operations.

4. Simulation of Sites Reservoir Delta and Storage Exchange Operations

Presenter(s): Tom FitzHugh & Puneet Khatavkar (Stantec)
Presenter(s) Email Addresses: thomas.fitzhugh@stantec.com; puneet.khatavkar@stantec.com
Collaborator: Shankar Parvathinathan (MBK Engineers)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Sites Reservoir Project includes operations to provide water supplies for partners South of the Delta (PWA exports to SWP Table A contractors, and CVP Refuge Level 4 deliveries), for storage exchanges with Reclamation in Shasta Lake and with DWR in Lake Oroville, and for environmental releases through the Yolo Bypass. These operations are coordinated through reservoir operations rules to provide benefits to multiple users, including storage exchanges to benefit SOD exports and also provide additional storage for Shasta cold water pool and additional flows for Sacramento River spring pulses and fall flow stability. This presentation will discuss the model development and testing that was undertaken to implement these operations. Model development included adjustment of carriage water operations for Sites releases for exports to prevent Delta or CVP/SWP impacts, and implementation of Sites Reservoir operations that consider outflow and release requirements for the Agreements to Support Healthy Rivers and Landscapes.

Session 25: Reducing Climate Change Uncertainty for Regional Water Resources Management
Session Moderator: Yuchuan Lai
Moderator Email: yuchuan.lai@tetratech.com

Improved projections of future regional climate change and associated impacts can provide critical information for regional water resources planning and facilitate enhanced long-term climate resilience in water supply. Recent advancements in diverse data sources, collection, and assimilation (e.g., remote sensing and reanalysis), climate and hydrologic modeling (such as climate change attribution and large ensemble climate model simulations), and application and integration of data-driven analytics (e.g., using machine learning and artificial intelligence) present great opportunities to reduce uncertainties in regional climate and hydrologic projections and facilitate long-term planning and decision-making. This session will focus on recent advancements in data availability, modeling, and analytic methods and provide critical insights on long-term impacts and opportunities, and facilitate improved water resources management.

1. ***Exploring the best available California climate model data for civil engineering use OR Is the best available climate model data sufficient to plan for climate adaptation?***

Presenter: Marie Buhl (UC Merced)
Presenter Email Address: mbuhl@ucmerced.edu
Collaborators: Sam Markolf (UC Merced)
Permission to Post PDF of Presentation on CWEMF Website: Yes

More states start to publish downscaled climate model data to be accessible for researchers and consultants. The data volume, depending on ensemble, spatial and temporal resolution can be very large and difficult to process for individual users. From a civil engineering point of view, values such as the 50yr extreme ground snow pressure and the 100yr extreme daily precipitation depth are data products of interest. Using CMIP6 LOCA (15 models) and WRF (5 models) downscaled data from the Cal-Adapt Analytics Engine I am exploring these values from various perspectives, such as climate scenarios, mid-century vs. end-century, methods and uncertainty with examples from individual locations. While preliminary results allow important insights, some questions such as user accessibility, data communication, limitations and consequences for engineering practice remain.

2. ***Advancing Climate Risk-Informed Flood Inundation Mapping: A Case Study of the Tuolumne River Watershed***

Presenter: Romain Maendly (DWR)
Presenter Email Address: Romain.Maendly@water.ca.gov
Collaborators: Darren Bonfantine (DWR), Chakri Malakpet (HDR), Ricky Doung (DWR), Asphota Wasti (HDR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

The California Department of Water Resources (DWR), in collaboration with the Federal Emergency Management Agency (FEMA) Cooperating Technical Partners (CTP) Program, has developed a climate risk-informed flood-inundation mapping approach to enhance flood hazard assessments under future climate conditions. This study focuses on the Tuolumne River watershed and integrates climate change projections with hydrologic and hydraulic modeling to assess system performance across different planning horizons. A hybrid modeling framework combining DWR's stress test analysis using a weather

generator with the latest General Circulation Models projection, accounting for climate uncertainty and non-stationarity while maintaining established standards of practice. Key results indicate that 100-year flood magnitudes will increase significantly, with flood extents expanding over time with climate change. By incorporating probabilistic climate risk assessments, this study moves beyond traditional floodplain mapping to provide decision-makers with data-driven insights for flood management, infrastructure resilience, and emergency preparedness. The findings underscore the importance of integrating climate science with advanced modeling techniques, offering a scalable methodology for climate-resilient water management in California and beyond.

3. Uncertainties in Assessments of Climate Change Impact on SWP/CVP

Presenter: Jianzhong (Jay) Wang (DWR)
Presenter Email Address: Jianzhong.Wang@water.ca.gov
Permission to Post PDF of Presentation on CWEMF Website: Yes

Since 2006, the California Department of Water Resources (DWR) has participated in the first, second, and fourth California Climate Change (CC) Assessments. These assessments have revealed significant uncertainties in climate change impact projections for the State Water Project (SWP) and Central Valley Project (CVP) regions, particularly regarding South of Delta exports, North of Delta carryover storage, and Delta salinity. The primary sources of these uncertainties include: (1) variations in General Circulation Model (GCM) projections and selection criteria, (2) differences in statistical and dynamic downscaling methods, (3) resampling techniques applied to downscaled GCM projections, and (4) approaches for incorporating climate change signals into water planning models such as CalSim, including surface hydrological modeling and perturbation ratio methods. These uncertainties affect both water supply components—such as future inflows and surface runoff—and water demand factors, including crop evapotranspiration rates. Additionally, the selection of sea level rise scenarios from GCM projections introduces further uncertainty into Delta salinity simulations, which, in turn, impact SWP/CVP water supply planning. This study evaluates uncertainties in CMIP3, CMIP5, and CMIP6 GCM projections and examines improvements introduced in CMIP6 using wavelet analysis of simulated historical precipitation. Furthermore, we analyze statistical and dynamic downscaling uncertainties through precipitation-temperature (P-T) interdependency assessments and trend analyses of downscaled P/T data. The practice of resampling multiple GCM projections into a composite projection is also scrutinized to determine whether the resulting dataset provides a more reliable representation than the ensemble mean. Additionally, we explore how transferring climate change signals from downscaled precipitation and temperature data into future rim inflows and water demand projections can sometimes lead to flow trends that contradict precipitation trends. This paradox is investigated through an analysis of surface hydrological models like VIC and perturbation ratio methods. Finally, we address the considerable uncertainty introduced by varying sea level rise projections in CC assessments, which significantly impact future South of Delta exports. To mitigate these uncertainties, we propose a series of strategic approaches aimed at improving the reliability of climate change assessments in California's water planning framework.

4. ***Constraining Long-term Streamflow Projections of Colorado River Basin for Improved Water Resources Management***

Presenter: Yuchuan Lai (Tetra Tech)
Presenter Email Address: yuchuan.lai@tetratech.com
Collaborators: Byeongseong Choi (U.T Arlington), Sujoy Roy (Tetra Tech)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Long-term water resource planning under climate change typically involves the use of hydrologic scenarios derived based on the projections from the Global Climate Models (GCMs), which can be subject to large uncertainty. Using probabilistic, time series modeling (state-space model, SSM), this work applies a parametric framework to analyze key underlying parameters determining the trajectories of long-term climate and hydrologic projections provided by GCMs (along with statistical downscaling and hydrologic modeling). The estimated key parameters based on the long-term GCM simulations are further used and constrained by historical observations to reduce uncertainty and provide improved projections. The study is conducted for the Colorado River Basin, which experienced a substantial reduction of annual streamflow starting from around 2000. The results show that this post-2000 decline in streamflow generally aligns with the projected decreasing trend from the SSM and further long-term decreases are expected. Compared to the existing GCM results, the SSM projections indicate future streamflow reductions with greater confidence. Additionally, a river system model (the Colorado River Simulation System model) is also used and integrated to simulate long-term river system operations and conditions such as Lake Mead elevations and water deliveries to California. The results suggest that – consistent with the projected long-term decrease in streamflow – sustainable long-term regional water supply may require additional adaptation efforts despite the extraordinary conservation measures that have been implemented in the recent years.

Session 27: Advancing Sustainable Water Management Through Flood Managed Aquifer Recharge: Insights from the San Joaquin Flood-MAR Watershed Studies
Session Moderator: Francisco Flores-López (DWR)
Moderator Email: Francisco.FloresLopez@water.ca.gov

Climate change poses unprecedented challenges to water resources management, exacerbating hydrological variability and increasing the frequency of extreme weather events. Nowhere is this more evident than in California's San Joaquin Valley, where the coexistence of flood risks, unreliable water supplies, and declining ecosystems underscore the urgent need for innovative solutions. In response, the California Department of Water Resources (DWR), in partnership with different water utility partners in the San Joaquin River Watershed, embarked on a two-year San Joaquin Flood Managed Aquifer Recharge (Flood-MAR) Watershed Studies - five studies including Calaveras, Stanislaus, Tuolumne, Merced, and Upper San Joaquin- to explore the viability of Flood-MAR as a comprehensive water management strategy in the San Joaquin River watersheds. The San Joaquin Flood-MAR Watershed Studies are state-of-the-art watershed investigations of Flood-MAR's potential to mitigate flood risks, improve water supply, enhance ecosystem health, and advance sustainable water resources management in California. Findings from the studies not only inform regional decision-making but also offer invaluable guidance and best practices for developing scalable Flood-MAR strategies in other regions grappling with groundwater and other water management challenges. The study showcases the synergistic potential of Flood-MAR in addressing complex water management dilemmas while contributing to sustainable water resource utilization in the face of climate uncertainty. The San Joaquin

Flood-MAR Watershed Studies and the four-part series presentations in this session are structured around four main objectives:

(1) Develop a state-of-the-art headwater-to-groundwater modeling toolset to facilitate shared understanding across water management sectors of climate vulnerability and Flood-MAR adaptation performance.
(2) Assess vulnerabilities to climate change across flood, water supply, and ecosystem sectors using a decision-scaling approach used to stress test the watershed under various climate scenarios.
(3) Formulate two adaptive Flood-MAR strategies that may be progressively implemented to provide added resilience and benefits across all water management sectors.
(4) Provide a template for future studies and projects highlighting the opportunities of multi-sector coordination and challenges of at-scale Flood-MAR implementation.

Through this comprehensive approach, the San Joaquin Flood-MAR Watershed Studies serve as a model for designing resilient solutions to address complex water management challenges under changing climate conditions. The study findings advance understanding and implementation of at-scale Flood-MAR strategies, contributing to sustainable water resource utilization regionally and beyond.

1. Development of a Headwater-to-Groundwater Integrated Modeling Toolset

Presenter: David Arrate (DWR)
Presenter Email Address: David.Arrate@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

The first presentation in the four-part series will provide an integrated modeling toolset overview and a deeper dive on how the various models communicate results. The resulting headwaters-to-groundwater toolset represents a state-of-the-art approach intended to provide information to multiple water management sectors, fostering a shared understanding of climate vulnerability and Flood-MAR adaptation performance. Through the integration of these models, water managers gain the ability to assess the region's potential to capture and recharge water, thereby meeting groundwater sustainability goals over time. Moreover, the toolset enables water managers to understand the performance of flood and recharge management adaptations and the effectiveness of these implementation decisions. Given the interconnectedness and inter-dependency of the water resources management, a watershed approach and multi-sector toolset are necessary for an effective evaluation of comprehensive solutions.

2. Assessing Climate Vulnerability

Presenter: Wyatt Arnold (DWR)
Presenter Email Address: Wyatt.Arnold@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

The second presentation in the four-part series will delve into the vulnerability assessment conducted as part of the San Joaquin Flood-MAR Watershed Studies. This presentation provides an overview of the approach and results from the integrated analytical toolset used to assess the vulnerability of the San Joaquin River watershed to climate change. Multi-sector metrics are employed to track performance under three primary water management sectors – flood risk, water supply, and ecosystem health. Climate change is incorporated using a “decision scaling” approach, which stress tests the San Joaquin watersheds, reservoirs, and aquifers under a wide range of temperature and precipitation changes. The results will demonstrate that each sector – flood risk, water supply, and ecosystem health – is vulnerable to climate

change. By understanding these vulnerabilities, decision-makers can better prioritize adaptation strategies and allocate resources effectively to enhance resilience in the face of climate uncertainty.

3. Enhancing Climate Resilience through Adaptive Flood-MAR Strategies

Presenter: Karandev Singh (DWR)
Presenter Email Address: Karandev.Singh@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

The third presentation in the four-part series focuses on the development and evaluation of adaptive Flood-MAR strategies as part of the San Joaquin Flood-MAR Watershed Studies. This presentation will explore climate vulnerability mitigation and added resilience provided by two progressive levels of Flood-MAR implementation considered in the study, ranging from diverting high flows for recharge to reoperating reservoirs and expanding infrastructure to capitalize on additional recharge potential. The outcomes demonstrate how utilizing existing infrastructure for groundwater recharge can improve water supply reliability. Moreover, partnering with flood and ecosystem managers on projects that integrate Forecast Informed Reservoir Operations (FIRO) with recharge can simultaneously enhance flood protection, improve water supply, and deliver ecological benefits. Finally, infrastructure improvements can increase the efficiency of applied recharge, requiring less land area.

4. Setting a Template for Multi-Sector Coordination

Presenter: Jim Wieking (DWR)
Presenter Email Address: James.Wieking@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

The fourth presentation in the four-part series highlights the significance as a template for future studies and projects, emphasizing the importance of multi-sector coordination and at-scale Flood-MAR implementation. Insights gleaned from the Watershed Studies serve as a blueprint for informed decision-making and collaborative action, catalyzing progress towards sustainable water management practices in California and beyond. Specifically, the presentation will discuss how insights from the Watershed Studies are informing the exploration of Flood-MAR implementation opportunities and challenges in addressing water management vulnerabilities across the San Joaquin River basin. Furthermore, this presentation will spotlight observations, findings, and engagement needs from each participant involved in the Flood-MAR effort, illuminating the collaborative process and the invaluable lessons learned.

Session 28: Applied Modeling for Effective Decision Support
Session Moderator: Tyler Hatch (INTERA)
Moderator Email: thatch@intera.com

In this session, we will explore applied modeling for decision support in environments characterized by uncertainty and limited data. Numerical modeling is a crucial tool in water resource management, capable of depicting the behavior of hydro(geo)logical systems under various scenarios, such as pumping or climate change. However, modeling these complex natural systems with constraints on data, time, and budget presents significant challenges. This session will discuss strategies to overcome these challenges, ensuring that modeling provides reliable and valuable insights for decision-makers.

1. ***Optimization of a Seawater Intrusion Barrier in Sunset Gap, Orange County, California***

Presenter: Nathan Hatch (INTERA)
Presenter Email Address: thatch@intera.com
Collaborators: Cecile Coulon, Abhishek Singh, Jeremy White (INTERA); Bill Leever, Tim Sovich, Roy Herndon (OCWD)
Allow to post to CWEMF website: yes

The Orange County Water District (OCWD) has a longstanding history of managing groundwater resources and protecting groundwater quality, including efforts to control seawater intrusion. Notable historical initiatives include the construction of two hydraulic injection barriers in coastal erosional gaps: the Alamitos Barrier in 1965 and the Talbert Barrier in 1976. Sunset Gap was historically considered less vulnerable to seawater intrusion due to geological faulting and the absence of a continuous, permeable shallow aquifer connecting to the Pacific Ocean, as found in other gaps. However, depth-specific monitoring wells have collected groundwater quality data over the past decade, confirming seawater intrusion in Sunset Gap. In the past year, OCWD has investigated the feasibility of implementing a combined injection-extraction seawater intrusion barrier in Sunset Gap. To evaluate this approach and determine maximum daily injection rates, numerical groundwater flow modeling was employed to analyze the seasonal variability in injection requirements for achieving protective groundwater elevations. This modeling also explored optimal configurations of injection and extraction wells under conditions of uncertainty, providing insights into the ideal number, spacing, and target aquifer units for a robust defense against seawater intrusion. An optimization framework was used to estimate injection and extraction rates, identifying the minimum necessary rates to effectively protect the basin from seawater intrusion. This optimization not only determined average and peak rates but also highlighted critical locations for injection and extraction wells. Additionally, it offered a deeper understanding of the hydrogeological dynamics of seawater intrusion and demonstrated how proactive operations could reduce the maximum rates needed to safeguard the basin.

2. ***Presentation Title: Model Emulation for Decision Support***

Presenter: Spencer Jordan (INTERA)
Presenter Email Address: sjordon@intera.com
Collaborators: Jeremy White, Rui Hugman, Tyler Hatch (INTERA)
Allow to post to CWEMF website: yes

Water Managers are looking for ways to build resilience in their water portfolios by making better use of their water resources while minimizing negative effects of groundwater pumping on ecosystem health and downstream users. Often the number of modeling scenarios need to get reduced due to limited resources. One approach to dealing with this is to develop a stochastic impulse response emulator, or model emulator. This allows rapid screening of numerous scenarios and selection of the best ones to run the more computationally demanding numerical model. This presentation discussed the set-up of a model emulator proof of concept using the Freyberg model to test out functionality for responses from pumping, recharge, and surface water flows on the model and conceptualization of a dashboard interface to allow user-friendly interactivity.

3. ***Presentation Title: Developing efficient and transparent groundwater modeling workflows to aid with decision support***

Presenter: Jeremy Bennett (INTERA)
Presenter Email Address: jbennett@intera.com
Collaborators: Catherine Moore (GNS Science), Rui Hugman (INTERA), Tara Forstner (GNS Science)
Allow to post to CWEMF website: yes

Groundwater modeling involves numerous steps to organize and clean data, develop the model grid, parameterize, and calibrate. Often these steps are undertaken manually or may involve both manual and scripted steps which can present problems for repeatability if detailed workflow documentation is not developed at the time. As a result, model updates or integrating new team members may be challenging and costly. In other cases, models are developed in a way that makes updating the model structure, implementing predictive scenarios or changing predictions of interest challenging within a decision-support context. Fully scripted modeling workflows offer a potential solution by organizing the transformation of raw data into model inputs, writing model input files, running model simulations, and post-processing model results. This can take some effort up front to set-up but for repeated model updates for management purposes and scenario analysis this can provide tremendous time and cost savings. In this presentation, we discuss a case study for how a fully scripted workflow was implemented, including the tools used and lessons learned. We will also discuss what role machine learning operations (MLOps) can play in enhancing groundwater model workflow transparency, reproducibility, and efficiency while adhering to FAIR (Findable, Accessible, Interoperable, Reusable) principles.

4. ***Presentation Title: The Adjoint State Method: Highly Scalable Sensitivity Analysis***

Presenter: Jeremy White (INTERA)
Presenter Email Address: jwhite@intera.com
Collaborators: Mohamed Hayek (INTERA)
Allow to post to CWEMF website: yes

Sensitivity Analysis is useful for understanding relationships between model parameters and model outputs and be very informative for inverse modeling. Often sensitivities are calculated with a direct relationship between the perturbation of parameters to model outputs of interest, which can lead to many model simulations. The Adjoint State Method is a highly efficient approach for calculating sensitivity coefficients. INTERA has recently developed an adjoint sensitivity capability for MODFLOW 6 (code MF6ADJ). In this presentation, adjoint state theory is briefly introduced, along with use cases, and example applications demonstrating large performance gains. For example, Leake and others (2010) developed a capture map by performing thousands of simulations perturbing parameters in each grid cell of a model to estimate the contribution of water from a stream to pumping, a so-called capture map. Performing this same calculation using the Adjoint State Method can be undertaken with only two simulations.

Session 29: Science in a Changing Climate
Session Moderator: Steve Andrews (RMA)
Moderator Email: steve@rmanet.com

Although this is a grab bag session of talks, it will focus broadly on climate adaptation – from science initiatives incorporating more extreme events, to modeling studies, modeling development, and best management practices designed to cope with a changing climate.

1. The Delta Science Program's collaborative open science initiatives

Presenter: Lisamarie Windham-Myers (USGS, Delta Science Program)
Presenter Email Address: lisamarie.windham-myers@deltacouncil.ca.gov
Collaborators: Maggie Christman, Denise Colombano, Ben Geske (Delta Science Program)
Permission to Post pdf of Presentation on CWEMF Website: Yes

California's Mediterranean climate is rapidly evolving toward unprecedented volatility, where droughts, floods, heatwaves, and wildfires are becoming more frequent and severe. This volatility challenges the current infrastructure, resource allocation models, and science-informed approaches used to govern and manage the state's natural resources. In this presentation, I will introduce a suite of collaborative open science initiatives supported by the Delta Science Program aimed to address our new climate realities. First, I will explore key findings from the 2025 State of Bay-Delta Science (SBDS) review articles focused on the current state of science and management of extreme climate and weather in the Delta. Next, I will highlight the SBDS editorial board's perspectives on promising avenues to advance science and governance in the era of climate change. Finally, I will showcase new and existing efforts to build capacity in collaborative open science and synthesis, including the start of three projects in 2025 to support development of the Delta Collaboratory. Throughout this presentation, I will focus on solution-oriented initiatives to advance science-informed management, which is a main focus of the upcoming revision to the Delta Science Plan.

2. Modeling Water Security Strategies Under Changing Climate for Nevada Irrigation District

Presenter(s): Hamideh Habibi (WEST Consultants, Inc) & Jared Emery (Western Hydrologics)
Presenter(s) Email Address(es): hhabibi@westconsultants.com, jared.emery@westernhydrologics.com
Collaborators: Jennifer Hanson, Doug Roderick (Nevada Irrigation District); David Curtis, Luciana Cunha (WEST Consultants, Inc), Jeffrey K. Meyer (Western Hydrologics); Katherine Klug (Davids Engineering); Megan Lionberger (HDR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Nevada Irrigation District (NID) is proactively addressing the community's long-term water needs through its Plan for Water, a collaborative initiative designed to assess NID's current and future water supply and demand. To support this effort, three numerical models were developed: a physically based hydrological model to represent current and future runoff conditions within NID area, a demand model to estimate projected demands for a 50-year planning horizon, and a reservoir operations model to simulate the operation of the NIDs storage, conveyance, and delivery system. These models were employed to evaluate strategic alternatives under three climate scenarios: (1) Dry Future Climate with High Demands, (2) Median Future Climate with Baseline Demands, and (3) Wet Future Climate with Low Demands. These scenarios provide dry and wet bookends with a median climate scenario. Seven strategic alternatives were investigated to assess their potential to improve water security under projected climate conditions. The benefits of each strategic alternative were compared against a baseline scenario. Changes in average annual delivery, average annual unmet demand, and average annual carryover storage were calculated relative to the baseline to assess the relative benefit of each strategic alternative. This analysis was performed for all climate scenarios. Each of the strategic alternatives included in this analysis resulted in a net increase in water deliveries to NID customers under various climate and demand projections. This project produced an invaluable set of long-range decision tools that can be applied to guide NIDs water management on how to mitigate risks to water supply.

3. Restoring Watershed Function and Recharging the Local Aquifer

Presenter: Ricardo Aguirre (WEST Consultants)
Presenter Email Address: raguirre@westconsultants.com
Collaborators: LAND MANAGEMENT: Jackie Watkins and Joaquin Solis (Cochise County),
GROUNDWATER RECHARGE: Ron McEachern (Central Arizona Irrigation and Drainage District), Don Clark (Terracon), Bob Strand (Cascade Technology Solutions), Gilbert Davidson (Town of Prescott Valley),
Lacey James (Salt River Project)
Permission to Post pdf of Presentation on CWEMF Website: Yes

In 2021, the Bureau of Reclamation enacted the Tier 1 water shortage in Arizona, rationing farmers from Colorado River Water within the Pinal Active Management Area, consisting of the highest concentration of Arizona's farmlands. Other areas that have not been receiving Colorado River Water are dealing with annual overdraft of their local aquifer and are becoming increasingly concerned about water scarcity. In response to this, certain local governments throughout the state as well as the state government have been seeking alternative water sources to achieve long-term water security. Typically treated as a nuisance, stormwater is now being considered as an asset. As such, this presentation explores harvesting stormwater through 1) watershed restoration and taking advantage of the relationship between soil carbon and soil water holding capacity, 2) enhancing retention and detention basins with an infiltration technology that might work for rapid deep percolation of stormwater, that would otherwise be evaporated, to recharge the local aquifer, and 3) a vison for putting the two together to create a duplicable surface water to groundwater recharge approach that could have both municipal and agricultural applications.

4. A methodology for long-term habitat suitability assessment in Coyote Valley, CA

Presenter: Megan Casey (cbec eco engineering)
Presenter Email Address: m.casey@cbecoeng.com
Collaborators: Toby Stegman, Aaron Katz, and Greg Kamman (cbec eco engineering)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Coyote Valley Conservation Areas Master Plan aims to identify opportunities for natural flood peak attenuation and restoration of wetland habitat in Coyote Valley, which hosted historic wetlands located between San Jose and Morgan Hill, CA. To aid in determination of the potential to rehabilitate wetland habitat in Coyote Valley, existing habitat conditions for native herpetofauna, shorebirds, and waterfowl were assessed using hydrologic and hydraulic (HEC-HMS and HEC-RAS) models and R-code scripts. This assessment was necessary to provide insight into how inundation varies based on water year type and antecedent conditions; however, a multi-year simulation was impractical due to long run times and the high amount of memory required to store model results. To lessen the required computation power while maintaining accuracy, five water years representing critically dry to wet conditions were selected for modeling in HEC-RAS. To further reduce simulation time, a low flow threshold of 10 cfs at the outlet of the main channel through Coyote Valley (Fisher Creek) was implemented, and only periods of each water year with streamflow greater than 10 cfs were modeled. The high flow simulations provide insight into the impact of varying storm sizes and antecedent moisture conditions on inundation in Coyote Valley. To capture low flow conditions, steady flows were modeled at each integer from 1 – 10 cfs. The low flow model results were paired to observed low flow periods of the selected water years to enable habitat suitability to be calculated over the full water years.

5. Improved Urban Drainage Modeling in HEC-RAS

Presenter: Stephen Andrews (Resource Management Associates, a GEI Company)
Presenter Email Address: steve@rmanet.com
Collaborators: Mark Jensen, Eric Tichansky, Alex Sanchez; Anton Rotter-Sieren (USACE-HEC); Rusty Holleman (RMA/GEI)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The USACE Hydrologic Engineering Center's River Analysis System (HEC-RAS) software package allows users to simulate 1D and 2D unsteady flow through rivers and overland areas, flow through hydraulic structures, and sediment transport and water quality. It has a large user's base and is often used to predict and assess flooding impacts over large areas during high flow events. Previously, HEC-RAS's prediction of flow through underground drainage networks, a critical element of urban flooding, was limited. Pressurized flow was handled using the Preissman slot approximation, leading to model instabilities and incorrect propagation times, and important network components such as drop inlets and junction boxes were missing. Recent updates to HEC-RAS program have been made to improve urban drainage modeling capabilities. Shapefiles containing georeferenced drainage network data are imported through the RAS mapper interface, and a computational grid is automatically created. The finite volume computational engine underlying the RAS 2D area computations was extended to handle pressurized flow in pipe networks. Pipe networks may be coupled to overland flow areas for dynamic interaction between surface and subsurface flows during large runoff events. The improved model was tested against analytic, observed, and SWMM (Storm Water Management Model) simulation results for accuracy and stability. Map view and profile visualization capabilities were added to the RAS Mapper interface.

Session 30: Managing Land Subsidence: Applied Modeling and Subsidence Best Management Practices (BMP)

Session Moderator: John Ellis & Jeremy White (INTERA)
Moderator Email: jellis@intera.com; jwhite@intera.com

Land subsidence caused by groundwater extraction has long been a significant challenge in California, with impacts including infrastructure damage, permanent loss of groundwater storage, and billions of dollars in associated costs. Minimizing and preventing future subsidence requires raising groundwater levels above critical head levels, typically historical lows. Achieving this necessitates coordinated efforts by local agencies to evaluate historical and current subsidence rates and implement management actions to minimize or avoid irreversible subsidence and meet the legislative intent of SGMA. In this session, we will explore the role of numerical modeling as a crucial tool for decision-makers to manage land subsidence and maintain compliance with SGMA's regulatory requirements. Numerical modeling is an effective tool for evaluating subsidence-related risks, determining critical head thresholds, and informing measurable objectives to reduce the rate and extent of subsidence. Discussions will focus on advanced modeling approaches, including the integration of multi-source data, and innovative workflows that enable uncertainty quantification and probabilistic scenario analysis. These methods ensure that modeling provides reliable and valuable insights, enabling GSAs to develop effective management plans. The session will also examine trade-offs between 1-D and 3-D modeling approaches, focusing on how to balance model complexity with practical application for effective decision-making. The session will also feature guidance from the California Department of Water Resources (DWR), offering technical assistance to support the implementation of the upcoming Subsidence Best Management Practice (BMP). A central focus will be critical head management, and approaches that combine operational flexibility with conservative strategies and alternative methods beyond modeling. Discussions will highlight the use of

applied modeling for decision support, while addressing limitations related to data availability and uncertainty. This session offers a comprehensive perspective on subsidence challenges under SGMA, providing valuable insights into data-driven subsidence management approaches and regulatory frameworks essential for the long-term management of subsidence.

1. ***Going Back to Go Forward—A case for using long-term data to improve land subsidence predictive tools and decision-making.***

Presenter: Leila Saberi (INTERA)
Presenter Email: lsaberi@intera.com
Collaborators: John Ellis, Andres Prieto-Estrada & Nathan Hatch (INTERA)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Land subsidence, driven predominantly by groundwater extraction, presents complex challenges for many areas of California. Since the introduction of SGMA, analytical and numerical tools have been developed to assist with groundwater management, but often rely on limited subsidence datasets. As a result, these short-term datasets may not capture the full range of subsidence dynamics, leading to potential inaccuracies in forecasting. A long-term dataset provides a crucial context for decision-making, allowing comparison of current subsidence rates with historical ones. In some areas, recent subsidence is a fraction of the cumulative subsidence, while in others, maximum subsidence rates are presently occurring. This historical record serves as evidence for the sustainability (or not) of current conditions. Additionally, the aquifer system retains a memory of the past maximum effective stress, which influences current subsidence. This factor can be analyzed in the historical record, explaining the differences in subsidence rates in locations with similar groundwater declines. Using long-term water level and subsidence data assists in reducing predictive uncertainty in forecasts of interest by better constraining model parameter values. Long-term subsidence and water level data were assembled for sites of interest in the southern Central Valley. One- dimensional MODFLOW models were calibrated to more than 100 years of data and used to predict subsidence through 2070. These predictions were then compared to the same models using only recent data. The results indicate that long-term subsidence datasets can improve the reliability of subsidence forecasts and scenario results, leading to more informed management decisions.

2. ***Integrating Multi-Source Subsidence Data and Ensemble Calibration for 1D Subsidence Modeling and Probabilistic Scenarios***

Presenter: Marisa Earll (INTERA)
Presenter Email: mearll@intera.com
Collaborators: Wesley Neely & John Ellis (INTERA)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Subsidence associated with groundwater extraction can threaten the operation of critical infrastructure leading to economic damages and impacts to beneficial uses/users of groundwater. Reliably forecasting the magnitude and time scales of subsidence using 1D subsidence modeling requires an understanding of past and current hydrogeological conditions. At 50 benchmark locations distributed across California's Central Valley, we leveraged historical and current water- level and subsidence to construct a long-term time series spanning 1900 to the present. Groundwater observations from state, federal, and local sources within a 2.5-mile radius of each benchmark are grouped by aquifer depth sampling, assessed for data quality and similarity, and joined together to create a long record of water-levels. The long-term subsidence time series relied primarily on leveling conducted at the benchmarks, with higher frequency

measurements from nearby GPS, InSAR, and extensometer data registered to the late-time leveling observations. Model calibration was conducted using PESTPP-IES, a localized iterative ensemble smoother designed to efficiently handle high-dimensional inverse problems. This calibration process iteratively refined prior parameter distributions, improving agreement between model outputs and observed data while quantifying uncertainties. The calibrated models were used to generate a range of probabilistic scenarios, including the historical minimum, critical head, and 2015 water levels, and pumping scenarios. This study demonstrates the value of integrating multi-source data with advanced ensemble-based calibration workflows to improve the accuracy of historical subsidence simulations and the reliability of forecast scenarios for effective management of current and future subsidence.

3. 1D vs 3D groundwater modeling to support decision making related to land subsidence in the Central Valley: appropriate simplification or do we need those extra two dimensions?

Presenter: Jeremy White (INTERA)
Presenter Email: jwhite@intera.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

The appropriate level of model complexity, typically associated with process representation and/or discretization, is key in modern-day applied groundwater modeling. Excessive simplification can lead to under estimation of uncertainty in important simulated outcomes or, worse, bias in those simulated outcomes. On the other hand, overly complex models typically suffer from numerical instability, extreme computational demand, and long development and deployment cycles (i.e. they cost a lot and are usually late). Within the context of groundwater management in the central valley, land subsidence induced from groundwater use is a well-known and continued critical management issue; modeling is typically used to evaluate expected future land subsidence under various possible groundwater-use scenarios. However, a spectrum of model complexity has been used and continues to be available to aid in managing land subsidence, ranging from simple 1-D column models to 3-D, integrated surface-water/ groundwater numerical models that (attempt to) explicitly represent many facets of the hydrologic cycle with high spatial and temporal resolution. Here, we compare and contrast the tradeoffs associated with using simple versus complex models to support management of land subsidence in central valley. These tradeoffs include accounting for the cost (in terms of time and money) of implementing the modeling, the ability to represent the important processes and scales related to land subsidence, and the ability to assimilate historical observations of land subsidence (i.e. learn from the available data), all in an effort to lay bare the important considerations when designing and undertaking land-subsidence analyses in support decision making.

4. DWR's Subsidence Best Management Practices and Technical Assistance

Presenter: Ben Brezing (DWR)
Presenter Email: benjamin.brezing@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Department of Water Resources (DWR) is developing a Best Management Practice (BMP) document to guide activities needed to meet the Sustainable Groundwater Management Act's legislative intent to avoid and minimize subsidence. Key takeaways from the BMP include: In regions prone to subsidence, all available subsidence and groundwater level data should be monitored frequently to inform adaptive subsidence management. To minimize subsidence, groundwater levels need to rise as quickly as possible above critical head levels. Critical head levels are typically above historical lows. Critical head can be

estimated with modeling approaches, or through analysis of the relationship between available subsidence and groundwater level time series data. Groundwater monitoring networks must provide measurements at extraction sites and at compaction-prone locations and depths, especially near infrastructure vulnerable to subsidence, with a high enough frequency (monthly) to support adaptive management. DWR's SGMA technical assistance includes: Quarterly updates to the statewide InSAR-based subsidence data on the California Natural Resources Agency's Open Data platform and SGMA Data Viewer. The InSAR dataset has a horizontal resolution of 100 meters and provides land subsidence measurements in monthly timesteps. In 2023, DWR started installing Continuous GPS and will begin installing InSAR corner reflectors to improve InSAR data coverage and fill subsidence monitoring gaps in 2025. As part of California's Groundwater (Bulletin 118) 2025 Update, DWR will release a compilation of co-located long term groundwater level and subsidence data, including NGS benchmark data from 1900 onwards. Through the Basin Characterization Program, DWR will be mapping areas susceptible to subsidence.

Session 31: Planning from the bottom-up: Modelling Central Valley and State Water Project operations at a daily timestep
Session Moderator: Harrison Zeff (University of North Carolina at Chapel Hill
Moderator Email: zeff@live.unc.edu

Long-term planning models often operate at temporal scales that are too coarse to fully capture the full suite of operational decisions in water management systems (e.g., flood control). This session will present several modelling activities that use novel modelling tools to simulate State Water Project (SWP) and Central Valley Project (CVP) operations at a daily timestep. The session brings together researchers working to make highly resolved projections of hydropower generation, water temperature, and forecast-informed reservoir operations (FIRO) related to SWP and CVP operations. Presentations will illustrate the challenges in developing, validating, and maintaining such models, as well as the opportunities they provide decision-makers to supplement existing operational models with more detailed short- and mid-term forecasts.

1. ***Development and application of a daily timestep water supply model (CALFEWS) for managing water supply-related financial risks***

Presenter: Dan Li (University of North Carolina at Chapel Hill))
Presenter Email Address: danli@unc.edu
Collaborators: Harrison Zeff & Gregory W Characklis (University of North Carolina at Chapel Hill)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Water markets are crucial in mitigating the effects of hydrologic variability on stressed water supplies, a challenge projected to intensify with climate change. California's water trading market, valued at $1.1 billion, is one of the largest in the world in terms of both quantity and value, and prices are strongly correlated with statewide water conveyance via the State Water Project (SWP) and the Central Valley Project (CVP). During extended drought periods, SWP and CVP deliveries to the San Joaquin Valley and Southern California are substantially reduced, leading to considerable volatility in water market prices. The price uncertainty poses substantial financial risk to local water users, particularly irrigators and municipal districts that rely heavily on water for their operations. Higher water costs during drought years can lead to budget shortfalls, lower credit ratings, and reduced infrastructure investment. This study employs a rule-based simulation model that represents California's complex water system at a daily timestep across surface water reservoirs, pumping stations, irrigation districts, and groundwater banks.

Using a seasonal ensemble of daily hydrologic conditions, future prices of the Nasdaq Veles California Water Price Index (NQH2O) are forecasted with a random forest model. When this model was used to evaluate water market risk for a large industrial almond farm, the hedging strategy—combining water futures contracts with spot market water purchases—was found to reduce price volatility, stabilize costs, and ensure more predictable water expenses in the face of environmental and economic uncertainties.

2. Using CALFEWS to forecast hydropower generation and consumption in the Central Valley Project

Presenter: Yash Amonkar (University of North Carolina at Chapel Hill)
Presenter Email Address: amonkar@unc.edu
Collaborators: Harrison Zeff (University of North Carolina at Chapel Hill), Eric Mork (Western Area Power Authority) & Gregory Characklis (University of North Carolina at Chapel Hill)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Modern water management projects involve meeting multiple and competing objectives, including flood control, long-term drought resilience, navigation, hydropower generation, minimizing environmental impacts, and meeting municipal and agricultural demands. Such projects often include dams, reservoirs, canals, hydroelectric power plants, and other facilities to achieve these objectives, complicating the use of simple statistical or optimization procedures to model them. Detailed accounting of downstream demands, project deliveries, flood risk considerations along with environmental rules is necessary to model reservoir releases and consequently hydropower generation. Optimizing for a single or a subset of these objectives leads to an overall local maximization of project utility, resulting in behavior significantly divergent from true operating conditions. Utilizing CALFEWS, a comprehensive open-source and rules-based daily simulation model of surface water in California's Central Valley, we analyze and forecast for the Central Valley Project (CVP), the total hydropower generation, and the "base resource" hydropower, that is the marketable portion of generation available after CVP internal demands are met. Results suggest that CALFEWS accurately models CVP's total hydropower generation, along with the internal demand for power CVP needs to pump water across different basins, while also accurately modeling related system characteristics such as reservoir releases, environmental flows, and downstream irrigation and municipal demands. Overall, this methodology provides insights useful in modeling hydropower generation and its associated financial risk in other complex water management projects and river basins.

3. California reservoir network optimization with daily ensemble hydrologic forecasts

Presenter: Jonathan Herman, University of California, Davis
Presenter Email Address: jdherman@ucdavis.edu
Permission to Post PDF of Presentation on CWEMF Website: Yes

Many of the water supply opportunities in California depend on the safe conveyance of infrequent, high magnitude flood events. However, there is a gap in timescale and spatial scale between the operational models used for flood control and the water supply models used for system-level planning. This study develops a model for the Sacramento-San Joaquin system that combines the benefits of both approaches: network optimization with routing and daily ensemble hydrologic forecasts. A model predictive control method is used to maintain target storage and downstream constraints, leading to a convex optimization problem solved on a rolling horizon. The ensemble forecasts are updated daily using a recently developed hindcast dataset from CNRFC HEFS. Results for the flood event of record (1997) show that the HEFS policy achieves most of the possible benefit of a perfect short-term (14-day) forecast. Extensions to CVP/SWP

water supply modeling with seasonal forecasts are ongoing, aiming to support downstream storage and groundwater banking opportunities while maintaining environmental flows.

4. Coupled System Operations and Water Temperature Simulation: Challenges and Opportunities for Shasta Reservoir and the Central Valley

Presenter: James Gilbert (UC Santa Cruz)
Presenter Email Address: jamagilb@ucsc.edu
Permission to Post PDF of Presentation on CWEMF Website: Yes

Many reservoirs in California's Central Valley are operated for a combination of flood control, power generation, water supply, and water temperature management. Time scales for operating to meet each of these objectives can vary from hours to months, with implications for outcomes at local sites and across the Central Valley system. For example, management of Shasta reservoir to maintain cold water salmon spawning habitat in the Sacramento River and to deliver water through the summer irrigation season requires coordination in operational actions and assessment of environmental factors across days and months while adhering to regulatory constraints and delivery goals distributed across the Central Valley. Although Shasta delivery allocations and release schedules can affect temperature management (and vice versa), conventional modeling tools tend to treat these processes separately: evaluation of seasonal temperature outcomes relies on known releases, and delivery reliability (CalSim) analyses do not account for dynamic feedbacks that may arise from temperature considerations. Furthermore, translation from monthly planning models to high temporal resolution temperature models requires data transformations that may obscure daily features important to temperature management outcomes. In this presentation I explore the interdependency of Shasta Reservoir operations for temperature management and water deliveries, as well as the ways in which conventional modeling approaches may hinder our ability to find options that better integrate multiple objectives. Recent temperature management examples and synthetic modeling scenarios will be used as case studies to illustrate analytical challenges while highlighting the potential for integrated modeling tools to provide valuable insights.

Session 32: The Why, How, and What of Decision scaling: How to Make Risk Informed Decisions in an Uncertain Future

Session Moderator: Alejandro Perez & Paul Shipman (DWR)
Moderator Email: Alejandro.perez@water.ca.gov; Paul.Shipman@water.ca.gov

Climate change continues to bring significant uncertainty to California's future, especially in water management. This session is designed to help attendees understand why to use decisions scaling, the basics of how to apply the methodology, provide some examples of applications of decision scaling, and provide resources that can be tailored to specific applications. The sessions will be a main presentation broken into chunks with different speakers presenting applications followed by an interactive discussion to answer any questions on how to apply decision scaling.

1. Why Decision Scaling: A Smarter Approach to Climate-Informed Water Management

Presenter(s): Romain Maendly & Andrew Schwarz (DWR)
Presenter(s) Email Address(es): Romain.Maendly@water.ca.gov, Andrew.Schwarz@water.ca.gov
Collaborators: Darren Bonfantine, Michael Anderson, Wyatt Arnold, Alejandro Perez (DWR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

The California Department of Water Resources (DWR) continues to refine its approach to climate change impact analysis by integrating advanced methodologies that enhance decision-making under uncertainty. Decision scaling offers a structured approach to assessing future climate conditions by linking system vulnerabilities with a probabilistic framework of climate projections. This methodology helps ensure that water management decisions are robust and adaptable in the face of uncertain climate futures. This presentation will highlight the value of decision scaling within DWR's broader climate resilience efforts, including its integration into existing frameworks such as the Climate Action Plan and other strategic initiatives. Attendees will gain insights into how decision scaling supports a more comprehensive response analysis, see examples of its application, and learn about available resources to tailor this approach to specific water management challenges.

2. How To Do Decision Scaling

Presenter(s): Wyatt Arnold, Karandev Singh, Paul Shipman (DWR)
Presenter(s) Email Address(es): wyatt.arnold@water.ca.gov, karandev.singh@water.ca.gov, paul.shipman@water.ca.gov
Collaborators: Alejandro Perez (DWR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

This presentation will provide an overview of basic steps common to all decision scaling applications including:

- Selection of robust hydrology dataset to give statistically significant results
- Identification of meaningful metrics
- Processing of GCMs to develop probability curves

Processes will be illustrated through examples from DWR's Watershed Studies and Future Scenarios projects. Both projects benefitted significantly from a decision scaling approach by providing a framework for a climate independent assessment of system response and a probabilistic approach to quantifying future uncertainty through the future GCM predictions allowing risk-based decision-making for future investments.

3. What Resources and Tools for Decision Scaling Climate Risk Analysis

Presenter: Alejandro Perez (DWR)
Presenter Email Address: alejandro.perez@water.ca.gov
Collaborators: Romain Maendly, Andrew Schwarz, Darren Bonfantine, Michael Anderson, Wyatt Arnold (DWR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

This presentation explores resources and tools for decision scaling in climate risk analysis, enabling users to tailor the analysis framework to their own systems and metrics of interest. Key topics include: future projection probability density functions (PDFs) development using CMIP5/6 General Circulation Models

(GCMs) at native or downscaled (LOCA/LOCA2) resolution; leveraging the Weather Generator Model to produce perturbed and stochastic climate data from paleo-climate, gage data, and gridded climate time series; developing multi-dimensional Response Surface Plots (RSP); quantifying risk by combining stress test RSPs with future projection PDFs to create the cumulative distribution functions (CDFs) to extract the risk value; and evaluating risk over time. The session will also explore how adaptation strategies can afford resilience to climate change impacts. Participants will gain insight into how these resources, tools and methods can be tailored to your system of interest to create robust risk-informed decision making under climate uncertainty.

Session 33: Hydrology and Climate Change
Session Moderator: James Polsinelli (DWR)
Moderator Email: James.Polsinelli@water.ca.gov

1. Snow Water Equivalent for Climate Change Scenarios

Presenter: Mohammad Hasan (DWR)
Presenter Email Address: mohammad.hasan@water.ca.gov
Collaborators: ZhiQiang Richard Chen, Alejandro Perez, and Andrew Schwarz (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Sierra Nevada snowpack serves as a critical freshwater resource, supplying nearly 75% of the region's water needs. Recent climate change warming has caused earlier snowmelt, increased winter flood risks, and reduction of snowpack. We use snow water equivalent (SWE) to quantify the water content in the snowpack, which has significant impacts on summer water availability for California State Water Project (SWP) and Central Valley Project (CVP). This study evaluated SWE under multiple warming scenarios (2043 1.5°C, 1.7°C, and 1.8°C; 2085 3.4°C, and 3.9°C), using the Variable Infiltration Capacity (VIC) model to simulate snowpack dynamics through 2043 and 2085 under the climate projections used in the California Department of Water Resources' (DWR) Delivery Capability Report (DCR) and Climate Adaptation Plan (CAP). In this presentation, we will compare our SWE results with the results from high-resolution models utilizing state-of-the-art climate simulation techniques (Beltran-Pena et.al 2024). Results indicate substantial SWE reductions across all scenarios, with the Northern Sierra exhibiting more pronounced declines. Notably, the traditional April 1st SWE benchmark increasingly underestimates total snowpack as peak snowmelt shifts earlier under warming conditions.

2. State Water Project Climate Adaptation Plan 2025
Presenter: Zachary Roy (DWR)
Presenter Email Address: zachary.roy@water.ca.gov
Collaborators: Raymond Hoang, Yiwei Cheng, Zachary Roy (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

This talk will discuss SWP's recently released (hopefully by the time of conference) Climate Adaptation Plan, the first of its kind. This Plan outlines numerous strategies that the SWP is implementing to adapt to climate change including 5 key strategies (Enhanced Asset Management, Forecast Informed Reservoir Operations, Delta Conveyance, California Aqueduct Subsidence project, and South of Delta storage) that are modeled in CalSim3 to quantitatively evaluate how these strategies alone and in combination help prepare the SWP for a hotter more extreme future. The talk will cover the future conditions that have been evaluated, the results of the analysis showing how each strategy provides climate resiliency, and key findings and priorities for implementation of these strategies.

3. CalSimHydro 2 Updates

Presenter: James Polsinelli (DWR)
Presenter Email Address: James.Polsinelli@water.ca.gov
Collaborators: Can Dogrul, Z.Q. Richard Chen, Jianzhong Wang, Mohammad Hasan, and Ruian Dong (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The CalSim 3 hydrology pre-processor, known as CalSim Hydro, has been updated to use the latest Integrated Demand Calculator (IDC, an IWFM product). The update to the IDC brings the hydrology generator up to date with the latest science used by DWR, and the added benefit of a fully supported system using modern programming languages and accessible compilers. In order to maintain an initial sense of consistency with past modeling, the new IDC was calibrated to the results of the legacy CalSim Hydro using the Model Independent Parameter Estimation and Uncertainty Analysis software suite, PEST.

4. 2085 Climate Change Operational Impacts and Baseline Assumptions

Presenter: Puneet Khatavkar (Stantec)
Presenter Email Address: puneet.khatavkar@stantec.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

For the purposes of simulating operations under 2085 climatic conditions, various water management actions are considered to address the projected imbalance between water supply availability and water demands, both for long-term operational policy changes and operations under short-term severe drought conditions. These actions are included in all scenarios for 2085 climatic conditions and are termed as 'Baseline Assumptions' for the purpose of DWR's Climate Adaptation Plan (CAP). The assumptions include Temporary Urgency Change Petition (TUCP) strategies implemented by State Water Resources Control Board, Water Demand (Agricultural and Urban) assumptions for dry and critical years, SWP and CVP operational changes and groundwater pumping changes to address long-term overdraft.

Session 34: The COEQWAL Project: Exploring Dimensions of Equity in California's Water Resources Systems

Session Moderator: James Gilbert (NOAA)
Moderator Email: james.gilbert@noaa.gov

This session brings together presentations on analysis being done as part of the COEQWAL (COllaboratories for EQuity in Water ALlocations) project. The project brings together academic research teams, agencies, and diverse publics to co-create scenarios representing combinations of possible water policy and operational changes under plausible future climates. The presentations in this session will introduce an equity framework and the modeling analysis being done to explore several use cases, including to inform meaningful measures of equity across different sectors in California's complex managed water system.

1. *Envisioning California's Water Future with the Collaboratory for Equity in Water Allocations (COEQWAL)*

Presenter: Wietske Medema (UC Berkeley)
Presenter Email Address: wmedema@berkeley.edu
Collaborator: Ted Grantham (UC Berkeley)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Achieving an equitable and sustainable water future for California requires inclusive, collaborative approaches to water planning. To address this need, we launched COEQWAL (COllaboratory for EQuity in Water Allocations), a research initiative that brings together academic teams and diverse publics to co-create future water scenarios. These scenarios integrate combinations of policy, infrastructure, and operational changes under plausible climate futures. Through a participatory research process, COEQWAL aims to reimagine California's water future by increasing understanding, broadening participation, and fostering deeper engagement in water management. Scenario outcomes are evaluated using *CalSim3*, a systems operations model, and made accessible through a public data platform featuring interactive visualizations and storytelling tools. This platform enables users to explore tradeoffs and implications of alternative futures in a transparent, engaging manner. In addition to the statewide focus, the project explores specific challenges, including salinity management in the Delta, recovery of the Sacramento River winter-run Chinook salmon, and access to safe drinking water for disadvantaged communities in the Central Valley. We highlight COEQWAL's collaborative, co-production approach and share key lessons learned from engaging diverse publics on complex and technical water issues. Equity is integrated throughout the project—from the design of tools and engagement strategies to scenario development. Preliminary findings underscore the importance of shifting power dynamics through intentional representation of marginalized communities, clearly communicating model limitations and flexibility, and using data storytelling and visualization to increase accessibility, understanding, and interest in California's water allocation decisions.

2. *Approach to evaluating winter-run Chinook salmon response to novel water allocation scenarios*

Presenter: Ann-Marie K. Osterback (UC Santa Cruz)
Presenter(s) Email Address(es): aosterba@ucsc.edu
Collaborators: Noble Hendrix (QEDA Consulting, LLC), James Gilbert (UC Santa Cruz), Eric Danner (NMFS)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Water is allocated throughout California's Central Valley to meet a variety of needs, including municipal and agricultural demands, demands related to health and human safety, and habitat to support aquatic species. Collaboratory for Equity in Water Allocation (COEQWAL) is a collaborative research project that is quantifying how well these various demands of water are being met, simulated both under current water allocation conditions, and under novel alternative scenarios with specific assumptions regarding future climate, infrastructure, and water management. As a part of COEQWAL, we developed a "Salmon Use Case", a case study focused on federally endangered winter-run Chinook salmon (*Oncorhynchus tshawytscha)* and using the winter-run Chinook salmon life cycle model (WRLCM), to serve as an example of how to evaluate the effect of each scenario on sensitive aquatic species. Through the Salmon Use Case, we will use the WRLCM to determine the population response of winter-run Chinook to each COEQWAL scenario, and compare how well the demands of salmon are being met in comparison to other water demands. We will share the general Salmon Use Case approach, how we have streamlined our modeling workflow to better support the COEQWAL project, and how we plan to integrate the salmon response

using metrics that support the broader COEQWAL goals. Ultimately, the Salmon Use Case will identify scenarios that best support salmon and also serve as an example of how biological models can integrate with the library of scenarios developed through the COEQWAL project.

3. Connecting water management, climate, and drinking water availability for surface-water dependent water systems in Central and Southern California

Presenter: Erik Porse (University of California Agriculture and Natural Resources, California Institute for Water Resources)
Presenter Email Address: eporse@ucanr.edu
Collaborators: Kristin Dobbin (UC Berkeley), Alvar Escriva-Bou (UC Davis), Josue Medellin-Azuara (UC Merced), Jenny Rempel (UC Berkeley), Sunny Singhal (UC Berkeley), Aneesa Gomez (UCLA), Yu Cai (UC Merced), Hope Hauptman (UCANR-CIWR), Benjamin Witeck (UCANR-CIWR)
Permission to Post PDF of Presentation on CWEMF Website: Yes

Communities throughout California rely on surface water supplies from both local and imported sources for drinking water. How could changes in operations and climate within the Sacramento-San Joaquin Delta affect water supply resilience in these communities? As part of a drinking water use case of the COEQWAL project, we are evaluating water supply resilience for water systems that use water from the Sacramento-San Joaquin Delta in central and southern California. We used interviews, workshops, and outreach to understand issues of concern for communities and the public regarding drought and future water supply. Since March 2024, we conducted 24 scoping interviews with drinking water industry partners and have conducted multiple public workshops with water systems, community-based groups, and others to get input on modeling scenarios that are of interest for collaborative modeling. Participants identified six scenarios of interest with: 1) prolonged and severe drought, 2) drinking water prioritized above other uses, 3) minimum human health and safety needs prioritized above other uses, and 4) functional needs of surface water reliant drinking water systems prioritized above other uses. To test such scenarios, we are developing network modeling that link water systems and sources of supply, including surface water, groundwater, recycled water, and imported or purchased water, and methods to evaluate economic impacts of shortages. These methods increase opportunities to incorporate community water system needs into CalSIM and other models. Additionally, we traced water supply distribution networks for deliveries from the State Water Project to community water systems in Southern California.

4. Salinity intrusion in a shifting Delta in a changing climate

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The Sacramento-San Joaquin Delta faces many challenges to remain a freshwater source for its ecosystems and the millions of Californians who depend on it for drinking water. The combination of warming temperatures, more frequent droughts and increased pumping means less freshwater is available to combat the salinity intrusion from rising sea levels. We investigate the impacts of a changing climate on salinity intrusion with simulations in the 3-D numerical model SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) implemented on a contemporary and future grid with currently approved tidally connected restoration projects. Model atmospheric forcing conditions are altered to be consistent with warming temperatures, and increased evaporative losses are accounted for

in the DeltaCD consumptive use model. Ocean boundary conditions are also altered to account for relative sea-level rise. Altered model forcings will illuminate the impacts of restorations on salinity intrusion and suggest locations especially vulnerable to increased salinity. These numerical experiments will provide a basis to compare the salinity impact of other potential future interventions that extensive public engagement has revealed are of broad interest for quantitative evaluation, such as larger scale restorations, Conveyance, and additional rock barrier construction.

5. Assessing Environmental Flow Regimes in the Central Valley Under Alternative Management Scenarios

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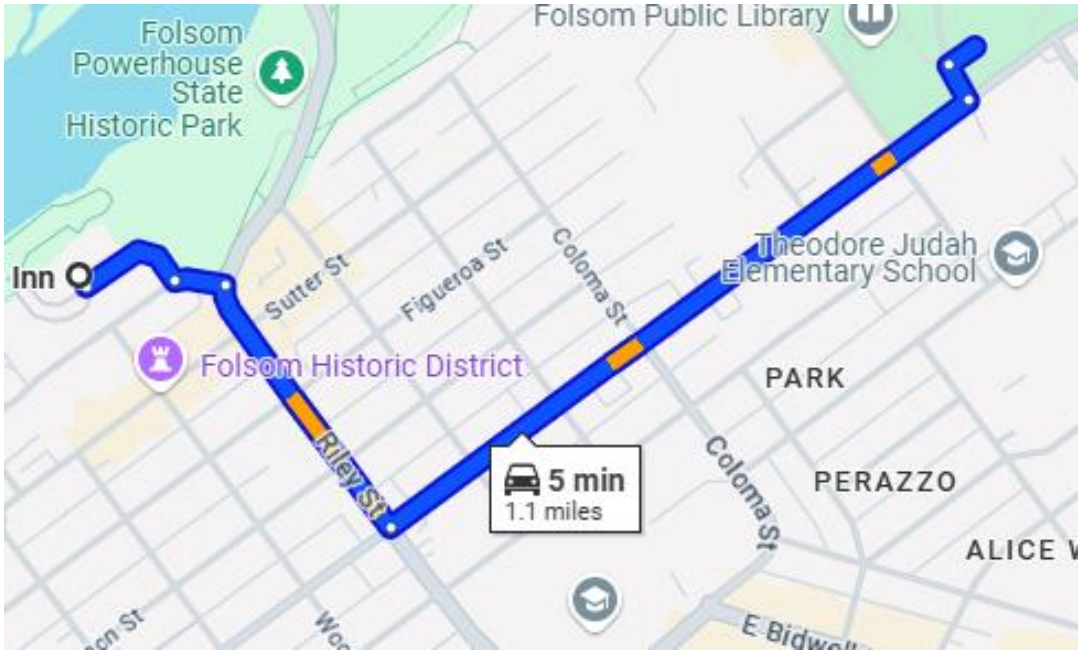
Collaborators: Bronwen Stanford (Nature Conservancy), Sarah Yarnell, Lindsay Murdoch (UC Davis); Ted Grantham (UC Berkeley)
Permission to Post PDF of Presentation on CWEMF Website: Yes

The natural seasonal flow patterns of Central Valley rivers in the Sacramento-San Joaquin Delta watershed have been profoundly altered by dams, conveyance infrastructure, and land use changes. These modifications have degraded habitats, reduced fish populations, and impaired essential ecosystem services. Environmental flows—water quantity and quality necessary to sustain ecosystem health—are crucial for sustainable water management. However, implementing environmental flows in the Central Valley may require substantial changes to water operations, with uncertain trade-offs for other uses. The COllaboratory for EQuity in Water Allocations (COEQWAL) is a publicly funded initiative that employs participatory scenario planning to enhance understanding of California's water future. Within this project, we evaluate how different water management strategies and climate futures influence the maintenance of environmental flows based on functional flow targets—key hydrologic components that support ecological processes—in the Sacramento and San Joaquin Rivers and their major tributaries. Our analysis demonstrates that these targets can be achieved by dedicating specific monthly water volumes as an environmental water budget, adjusted by river basin and water year type. Our findings underscore both the opportunities and challenges associated with managing environmental flows in the Central Valley, offering insights into the complex interplay between water operations and ecosystem outcomes.

(FOLSOM COMMUNITY CENTER: ROTARY CLUBHOUSE) 52 NATOMA STREET, FOLSOM



DIRECTIONS:

- Head northeast on Gold Lake Dr toward Leidesdorff St (0.1 mi)
- Turn left onto Leidesdorff St (230 ft)
- Turn right onto Riley St (0.3 mi)
- Turn left onto Natoma St (0.6 mi)
- Turn left (184 ft)
- Turn right (148 ft)

LIST OF LOCAL RESTAURANTS

1. Sutter St. Steakhouse – 604 Sutter St.
2. Plank Craft Kitchen + Bar – 608 Sutter St.
3. Folsom Hotel – 703 Sutter St.
4. Q'Bole! Mexican Cocina & Cantina – 718 Sutter St #201
5. Gaslight Co. – 718 Sutter St. #200
6. Riley's on Sutter – 702 Sutter St Ste M
7. Hop Sing Palace – 805 Sutter St
8. Pizzeria Classico – 702 Sutter St
9. Scott's Seafood Roundhouse – 824 Sutter St.
10. Sutter Street Taqueria – 727 Sutter St
11. Fat Rabbit Public House – 825 Sutter St.
12. Mystique Dining – 611 Sutter St.
13. Samuel Horne's Tavern – 719 Sutter St.
14. The Vine Folsom – 609 Sutter St.
15. Folsom Café – 727 B Sutter St.
16. Powerhouse Pub – 614 Sutter St #D
17. Represa Grill – 703 Sutter St.

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