BUREAU OF RECLAMATION

CVP Water Temperature Modeling Platform, Modeling Technical Committee Meeting #8

Thursday, April 6, 2023; 1:00 p.m. – 4:00 p.m.

Meeting Objectives

- Provide an effective venue for topic-specific discussions under the Modeling Technical Committee (MTC) framework.
- Establish common understanding on the results of the last watershed model preparation – Stanislaus River system and opportunities for input.
- Provide updates on the approach and progress on characterizing model uncertainty.
- Provide common understanding of the planned standardized outputs and visualization options.

Agenda

See 20230406 WTMP MTC08_Agenda_Accessibility.pdf

Attendees

See 20230406 WTMP_MTC08_Participants_Accessibility.pdf

Summary

The MTC met to establish a common understanding of project status and upcoming topics of MTC discussions and provide opportunities for input on interim products and collaboration. The eighth MTC meeting was conducted in a consistent format as previous MTC meetings. The main topics included providing an update on WTMP development, activities, and schedule; establish common understanding on the results of the last watershed model preparation, Stanislaus River system and opportunities for input; providing updates on the approach and progress on characterizing model uncertainty; and providing common understanding on the planned standardized outputs and visualization options. Opportunities were afforded for follow-up questions and exchange of ideas. This 3-hour online meeting was attended by 35 participants among 51 registered. The next MTC meeting is scheduled for 7/6/2023 from 1:00 p.m. – 4:00 p.m.

Meeting Logistics and Welcome Remark

Mr. Yung-Hsin Sun (Sunzi Consulting) started the meeting with a review of the agenda and logistics. Mr. Sun also provided a brief review of future agenda topics for the MTC meetings and updates on the project website, which includes meeting information, fact sheets, and deliverables. Mr. Sun proceeded to facilitate the MTC meeting.

Featured Discussion: Project Status Update

Ms. Randi Field (Reclamation) provided a project status update. Ms. Field reviewed that the WTMP project tis to deliver quality products to support Reclamation's mission to predict water temperature to support CVP operations. The WTMP project is the technical tool development effort to build the model and supporting mechanisms for water temperature management analysis.

The use of the WTMP is for operation teams to establish how to apply tools and analysis for water temperature management. The intended outcome for the WTMP is to create a living modeling platform to support long-term CVP operations by addressing water temperature modeling needs and challenges. Major products from this current project include complete model and platform documentation based on the current installation, the water temperature management platform, outcomes from independent scientific peer review (mid-term and final), and outcomes from the MTC collaboration (communications and participations in product review).

Reclamation is partnering with Delta Stewardship Council (DSC) for the peer review process. The final review is scheduled for 9/12/2023 to 9/14/2023 with an anticipated final peer review report in early November 2023. Active and upcoming review requests include the modeling development Technical Memorandums (TMs) for all three systems (Sacramento/Trinity, American, and Stanislaus), modeling uncertainty TMs on sources of uncertainty and protocols for estimating uncertainty. Other remaining project milestones include MTC meetings 9 and 10 scheduled for this summer and fall, respectively.

The WTMP roll-out is anticipated in Spring 2024. The products from the current implementation will continue to evolve with additional development/refinements on individual models and overall platform.

Questions and Feedback

- A member asked after the roll-out of the WTMP, will Reclamation stop using HEC-5Q models? In other words, will the current HEC-5Q models be phased out?

  The team responded that Reclamation's goal of the WTMP is to modernize and improve the water temperature modeling for CVP operation. The current WTMP implementation does not include options for using HEC-5Q models. HEC-5Q models require different inputs compared to ResSim, mainly the meteorological inputs. The documentation for HEC-5Q is also incomplete. Incorporating the HEC-5Q models into the WTMP would require a lot of processing and is not within the current scope of the current project.

  The continued use of HEC-5Q models is up to the long-term operators and the associated watershed temperature management groups. The WTMP is anticipated to be accepted by these teams and used in future applications.

Featured Discussion: Stanislaus River Water Temperature Models – Calibration/Validation

The next discussion was led by Mr. Mike Deas (Watercourse) and focused on an update for the calibration/validation of the Stanislaus River water temperature models. The Stanislaus River system includes a series of reservoirs and rivers, including New Melones Lake, Tulloch Lake, Goodwin Dam, and Stanislaus River. Key features include the New Melones old dam, the CE-QUAL-W2 internal weir, and the ResSim withdrawal zone constraint. Data collected includes hydrology, water

temperature, meteorology (Green Springs) for boundary conditions and water temperature data used for calibration.

The Stanislaus River models include CE-QUAL-W2 models for New Melones Lake and Tulloch Lake. The ResSim models include New Melones Lake, Tulloch Lake, Goodwin Dam, and Stanislaus River below New Melones Dam. The W2 model development included collecting inflow and dam power operation data. The W2 model calibration included lake stage (water balance), vertical temperature profiles, and outflow temperature. The calibration parameters for New Melones and Tulloch Lake include evaporation coefficients, coefficient of bottom heat exchange and sediment temperature, solar radiation absorbed at the water surface, wind sheltering, vertical eddy viscosity, longitudinal eddy viscosity and longitudinal eddy diffusivity.

Mr. Deas showed examples of 2007 and 2012 modeled and observed temperature profiles and summary statistics for several locations on the Stanislaus River system. Overall, the Stanislaus model calibration was calibrated using available data with significant limitations. The model performance was good considering the data challenges. The resulting CE-QUAL-W2 and ResSim models are ready for general water temperature planning studies. However, for more detailed studies, additional data is required.

The data limitations created a notable challenge for the upstream boundary conditions for New Melones model calibration. Specifically, the lack of consistent, long-term, comprehensive monitoring at several locations has a direct impact on model performance on all downstream systems. From this work comes the recommendation to develop a comprehensive and robust monitoring program. The continued implementation of WTMP will include additional model development, if warranted, and calibrated/re-calibrated based on additional available data.

Questions and Feedback

- A member asked if at this point in the project if it was too late to provide the team with additional Stanislaus data.

  The team responded that they will still accept data that is available.

- A member asked about how model bias affects the results when running over several simulation years.

  The team responded that potential bias, especially consistent bias, is to be avoided during the calibration process. In addition, the reservoir temperature (and thus, the simulated temperature in the model) resets at the beginning of every year, minimizing the risk of propagating bias, if any, over years.

- A member commented that the model calibration results seem further apart from the observed data in the winter and asked if this could be caused by winter stratification.

  The team responded that there may be inconsistencies in the meteorologic data, specifically short wave radiation and cloud cover. Corresponding short wave radiation and cloud cover (which has a direct impact on long wave radiation inputs to streams and lakes) are not coincidentally available. This is an example of the need for acquiring good meteorologic data for the Stanislaus River system.

- A member asked if/how smoke due to large wildfires was considered in the model calibration.

  The team responded that solar radiation is lower with smoke. The smoke particles in the air absorb solar radiation and emit long-range radiation. This is a difficult phenomenon to simulate. Although such conditions are represented in the meteorologic data was used for model calibration, this process was not explicitly represented in the model.

- A member asked how the CE-QUAL-W2 model and the ResSim model work with each other in the WTMP.

  The team confirmed the two models can be used and added that the WTMP allows the user to select which models to run, either individually or as a series of models.

- A member commented that the calibration results of CE-QUAL-W2 2012 Tulloch Lake model do not match the observed temperature profile very well for April near the reservoir surface. The member asked if the team has tried to refine the model's reservoir layers close to the water surface. Closer matches would allow the model to be used for other purposes like algae bloom prediction.

  The team responded that they have refined the Tulloch Lake W2 grid and have implemented a more representative mixing mechanism at the head portion. The improved grid representation has shown improved temperature profiles. As for the application for algae bloom prediction, The current models are calibrated for managing water temperature for fishery protection. For a different water quality modeling need, such as algae bloom prediction, different model calibration approaches and metrics would be used.

- A member asked how the model would perform under very low reservoir conditions, like in 2015.

  The team responded that there was not enough available data to run the model calibration for 2015. This again echoed the need for additional data collection for the Stanislaus River system.

Featured Discussion: Highlights of Model Development TM (Sacramento/Trinity and American only)

Mr. Deas highlighted the model development TM for the Sacramento/Trinity and the American River system. The TMs were distributed on 4/4/2023 and comments are due by 5/2/2023. A revised version is expected in late May 2023 for MTC review; it will include revised sections for the Sacramento/Trinity and American River systems with MTC comments incorporated and a new section for the Stanislaus River system. The model development efforts are expected to be complete in May 2023 after incorporating the MTC comments.

This discussion is meant to aid MTC members in reviewing the TM with substantial information. The TM employed good modeling practices from the protocols established by California Water and Environmental Modeling Forum. The TM discusses the multiple models and multiple systems that underwent extended calibration periods. Detailed background on the systems/basins, unique attributes and data development are included. The calibration approach and sensitivity analysis are also documented. The extensive model performance information was produced by using WTMP's

automated reporting functions. Overall, based on performance measures, the calibrated models are adequate for their intended applications.

The team added that all comments are welcome, particularly focused on the calibration and sensitivity approaches and a river basin of interest. There are some minor issues (such as formatting and style inconsistency) that will be addressed in the revised version. The team thanked the MTC members in advance for their comments and feedback.

Questions and Feedback

- No questions or comments.

Featured Discussion: Model Uncertainty

Mr. Deas discussed model uncertainty, particularly the approach to identifying and characterizing uncertainty and interim findings and anticipated outcomes. This discussion focuses on better characterizing the sources of uncertainty and treatments in WTMP implementation (model and forecasting) and exploring effective means of communicating uncertainty.

Properly informed decisions and actions require understanding of uncertainty associated with the predicted quantity of interest. There are four general areas of uncertainty and treatment in WTMP modeling: facility installation, observed data, forecast data, and system representation. Additional identified areas of uncertainty are parameters estimated for calibration, model output used as model input, and different models such as HEC-ResSim and CE-QUAL-W2.

The uncertainty protocol activities include developing estimates/estimation procedures for uncertainty in datasets and models identified as potential sources of uncertainty, including forecasts; develop estimates/estimation procedure for translating uncertainty through the modeling system to model results; and apply models to a range of simulations and develop potential approaches to communicate uncertainty in model results. Uncertainty associated with calibrated models resides in the predictive/forecasting estimation process. Therefore, the focus for model applications is input forecast uncertainty, including initial conditions and boundary conditions. The propagation of uncertainty through models can be associated with assumed initial conditions and forecast of boundary conditions. The uncertainty implications can cause a system response in large reservoirs, small reservoirs, and river reaches.

There are a range of approaches to estimating uncertainty for forecasts that can be accommodated by the WTMP, including single scenario, selective scenarios, ensemble, and multi-model ensemble. Other approaches include position analysis, Monte Carlo analysis, and others. The current project implementation will focus on the approach with selective scenarios.

There are a wide range of options to communicate the uncertainty, including tabular, graphical, or other formats. This is still under development. Reporting uncertainty in summary statistics via chart ranges is one option. Some considerations when characterizing uncertainty in the WTMP framework include understanding that the WTMP is a tool and not a decision-making body. The WTMP models represent an approximation of a combination of complex natural processes and built river-reservoir systems, and is thus a pragmatic approach for framework implementation and provides the ability to assess benefits. The next steps on model uncertainty include model application and documentation.

Questions and Feedback

- Regarding model calibration, a member asked if there was a way within the WTMP to select a period over which to review the bias for a selected season (for example wet or dry periods) versus over the entire calibration period.

  The team responded that the seasonal performance of calibrated models is discussed in the TMs and will be available for this round of review. However, it is important to recognize that, as the team reported in previous MTC meetings, there were no observed consistent biases to change the one model approach. Seasonal fitting with additional use of model parameters increases the risk of model applications. Therefore, model calibration required a balance between the goodness of fit and the number of parameters used for modeling tuning. The team used an extreme case for illustrative purposes. Using a second-degree curve to fit three data points can have a perfect match; thus, it minimizes the perceived errors of the calibrated model. However, if using this fitted model for prediction purposes, then the uncertainty for the predicted value is infinite because the uncertainty associated with the estimated parameters of the curve cannot be assessed.

Featured Discussion: WTMP Output and Visualization

The next discussion by Mr. John DeGeorge (RMA) addressed the WTMP output and visualization. Mr. DeGeorge gave a general overview of the components of the WTMP and the WTMP analytics framework, and an example of the WTMP user interface that allows the user to set a model study and generate reports. Mr. DeGeorge reviewed the HEC-WAT/WTMP terminology, such as study, simulation, and data management system, and showed how to assess information from the HEC-WAT study tree such as model alternative details, locating model directories, and access to time series data. There are model editing tools for the W2 model configuration and the ResSim model configuration. The WTMP has display edits, plots, tables that a user can access via display of schematic elements. HEC-ResSim has an interactive reservoir profile plotting tool that allows the user to view depth versus time contour plot, profile plot, and water quality time series based on the selected time and elevation. The design concept of the WTMP automated reporting considers the configuration of reports, plotting options, tabulation options, graphic options, and metadata. The user will be able to generate reports after running a simulation. The information generated for the reports will also be available in the model study folder in XML format, for example time series plots, contour plots, and monthly statistics tables. Mr. DeGeorge showed additional examples of time series plots, contour plots, and table objects. The WTMP platform can also accommodate additional needs after the initial deployment.

Mr. Sun reported that per member suggestions, there will be a subgroup discussion on WTMP output and visualizations. The subgroup is to allow members to refine the reporting capacity further, review the planned implementation, and discuss potential future improvements. There will be additional email communication about this output subgroup.

Questions and Feedback

- A member asked about whose role it will be to run model simulations and generate reports.

  The team responded that with the roll-out of the WTMP platform documentation and user guides on performing model simulations, forecasting, and generating reports will be provided. The purpose of sharing the model and facilitating common data access is to allow

users and entities other than Reclamation to conduct model simulations and generate reports.

Wrap Up and Next Steps

The meeting was concluded with the following next steps.

- Distribute model development TMs for review (all three systems).
- Continued Stanislaus River model development.
- Continued WTMP implementation and testing.
- Uncertainty characterization and communication.
- WTMP output subgroup in May 2023.
- Upcoming MTC Meetings and other major project events
    - CWEMF Annual Meeting (WTMP session on April 17), April 17-19, 2023
    - MTC 09 meeting, Thursday 7/6/2023; 1:00 p.m. – 4:00 p.m.
    - Final scientific peer review hosted by DSC, September 12-14, 2023.
    - MTC 10 meeting, Thursday 10/5/2023; 1:00 p.m. – 4:00 p.m.
    - Project completion, late 2023
    - WTMP rollout, spring 2024
- Next MTC Meeting: Thursday, 7/6/2023; 1:00 p.m. – 4:00 p.m.
    - A separate email will be sent out with meeting registration information.
    - Scheduled topics:
        - Model uncertainty
        - WTMP output and visualization
        - Other topics, as needed.