Modeling the Impacts of Climate Change on Lake Mead

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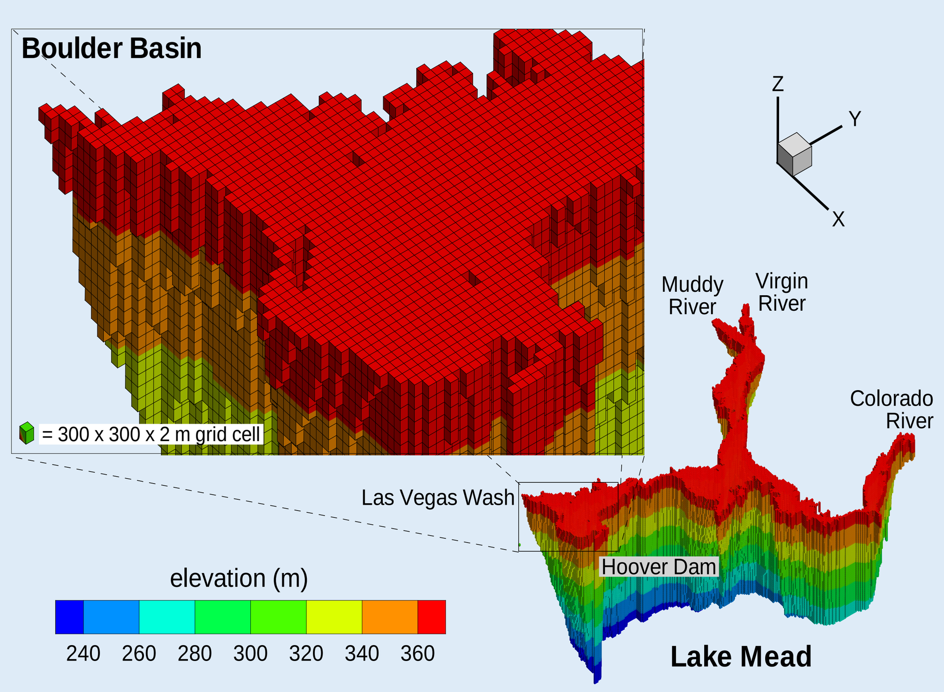
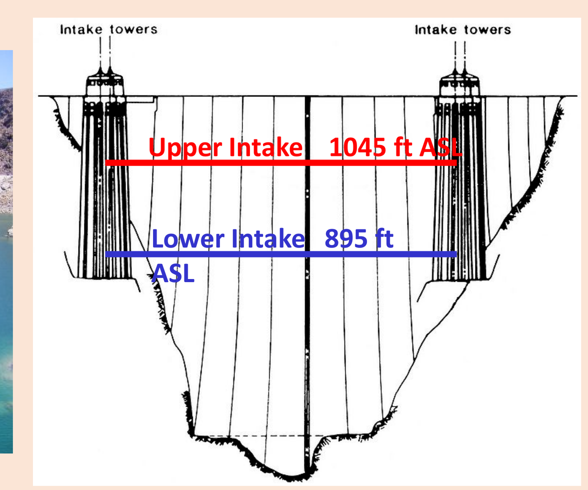
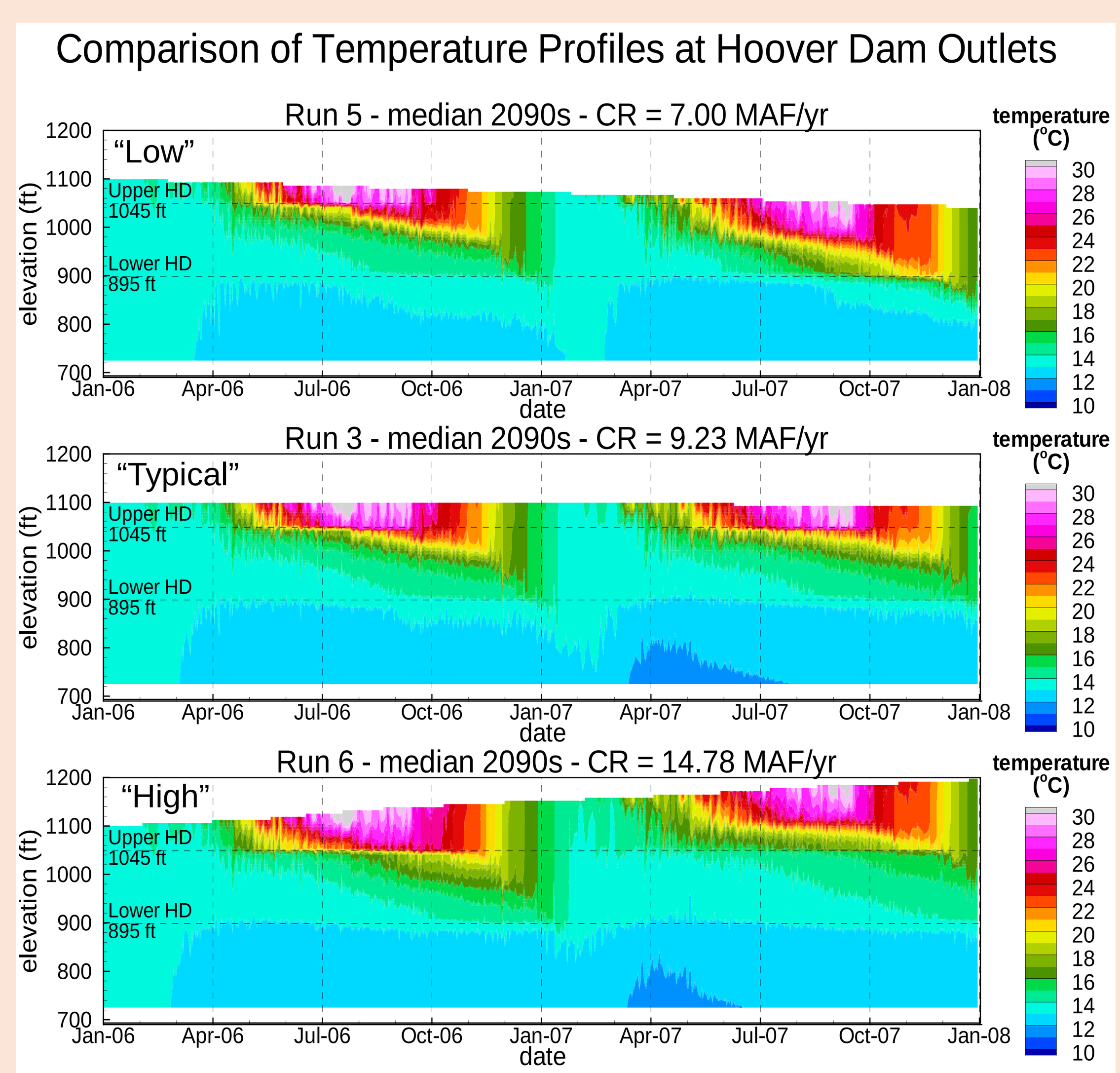
Lake Mead is a critical water resource in the west providing drinking water to millions, water for agriculture in Arizona and California, a recreation resource for millions of visitors each year, and critical habitat for endangered species, waterfowl, desert wildlife, and sport fish. The Lower Colorado River has been impacted for over a decade of drought and lake surface elevations have significantly decreased. While the changes to date have impacted use of the resource, we viewed these changes and the emerging consensus on climate impacts as an opportunity to use a 3-dimensional numerical simulation model to gauge potential impacts over a longer time period. The Lake Mead Model has been used in a range of management decisions and there is a high level of confidence that the simulations provide realistic simulations of future conditions given certain assumptions regarding forcing factors (air temperatures, inflow volumes, lake surface elevation). The conclusions drawn from the initial WaterSMART modeling suggest that climate change driven modifications may impact Lake Mead in the future, and that some of these changes will be influenced (positively and negatively) by the operation of the Hoover Dam Intakes.

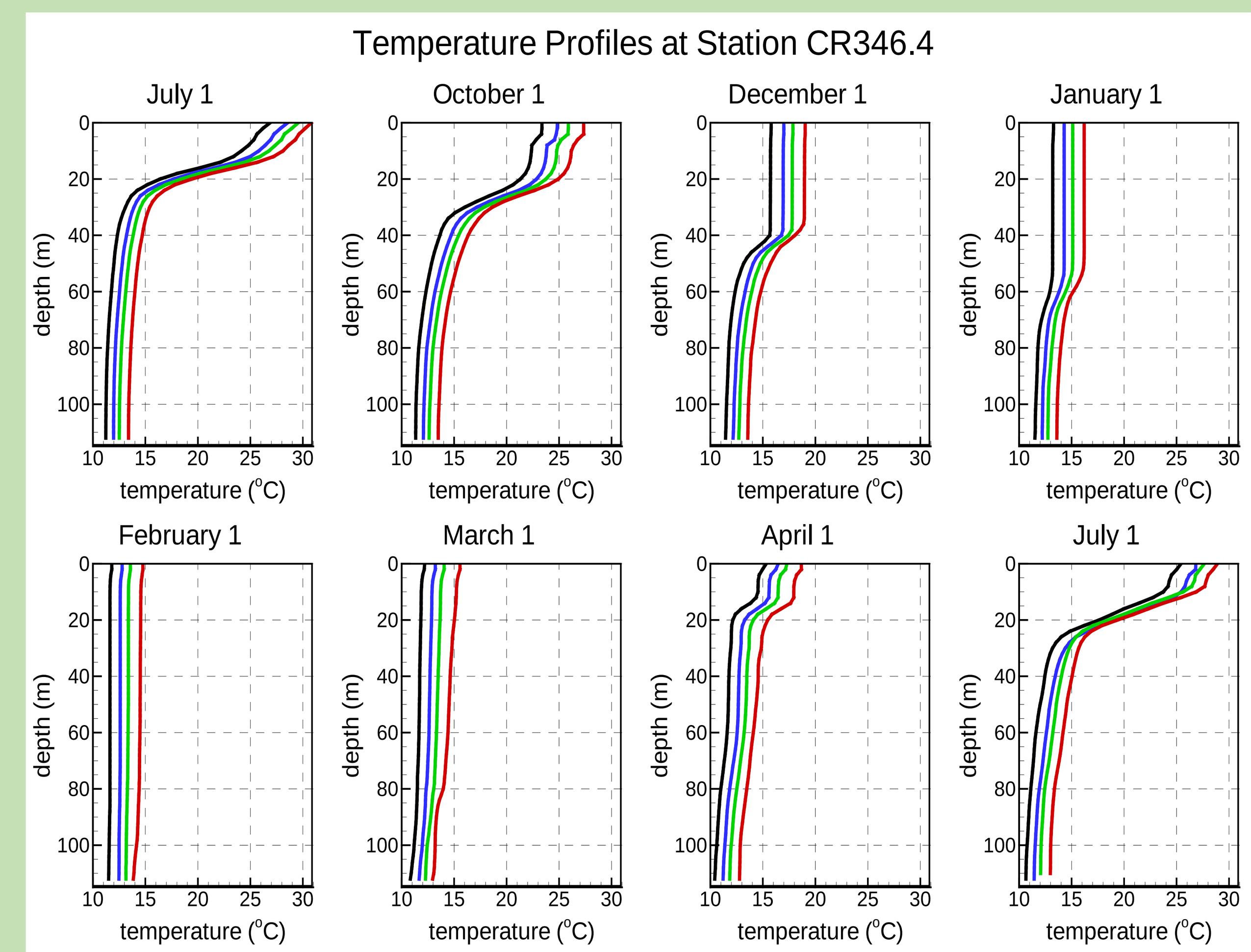


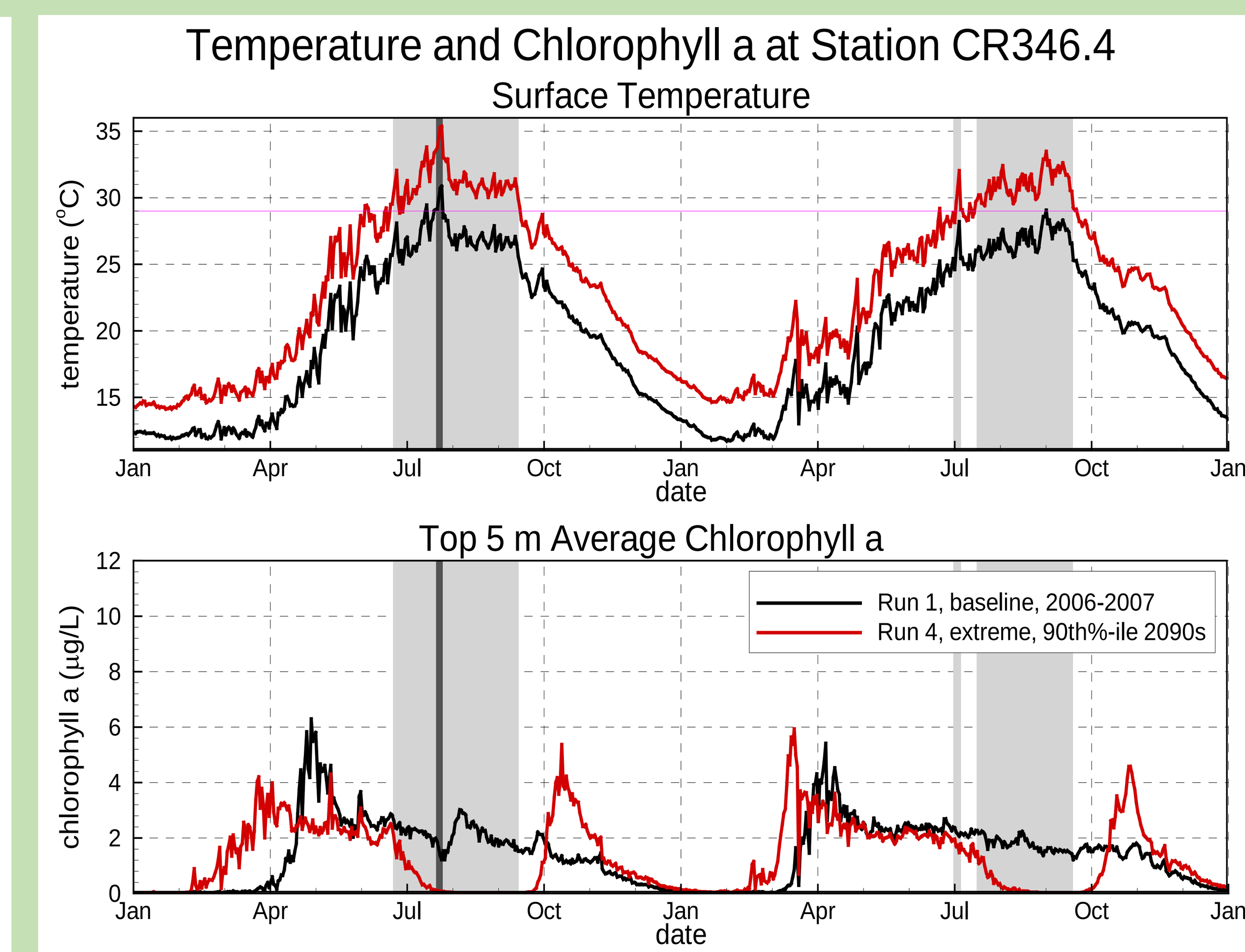
- The Lake Mead Model uses the ELCOM/CAEDYM codes to model 3-D hydrodynamics, stratification, temperature, salinity, conservative tracers, water quality, algae, dissolved oxygen, and other parameters
- The ELCOM/CAEDYM codes were developed by the Centre for Water Research (UWA)
- Development of the Lake Mead Model was funded by the Clean Water Coalition, SNWA and the National Park Service



The impact of the selection of withdrawal depth at Hoover Dam can have profound impacts on water quality by changing the residence time of the surface waters which are enriched with waters from the Las Vegas Valley.







The impacts of projected changes in climate variables produced changes in modeled output of the Lake Mead Model in predictable and less predictable ways. With increasing air temperatures the temperature of the water column is also expected to increase. This increase in the water column temperatures produced an unexpected change in algal biomass. Further modeling refinements were necessary to allow the algal community to "evolve" in response to changing climate.

Next Steps:

Past research and modeling have revealed that Lake Mead productivity is strongly regulated by the supply of bioavailable phosphorus. Currently the Colorado River is the largest source of phosphorus overall (much is not bioavailable) and the Las Vegas Wash is the largest source of bioavailable phosphorus. With increased water column temperatures comes stronger stratification and lower hypolimnetic dissolved oxygen concentrations. These increase the risk that release of phosphorus from lake sediments will come to play a more significant role in productivity management. This ecosystem component is included in the current Lake Mead Model, but has not been extensively tested. Current efforts are focused on revising sediment nutrient flux rates based on measured values, applying these revisions to the model, and then evaluating the potential impacts of climate change induced warming of the water column.