Enabling Water-Energy Decision Support Using Watershed-scale Surrogate Models

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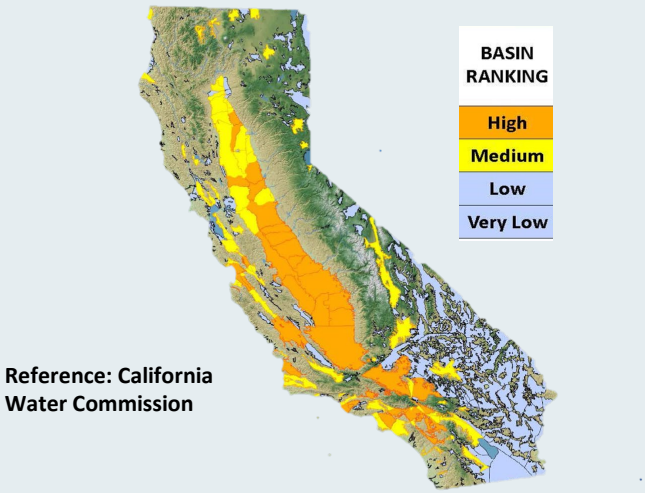
Motivation

The Sustainable Groundwater Management Act (SGMA) in CA requires that high-and medium-priority groundwater basins be managed such that a balance of pumping and recharge will be achieved.

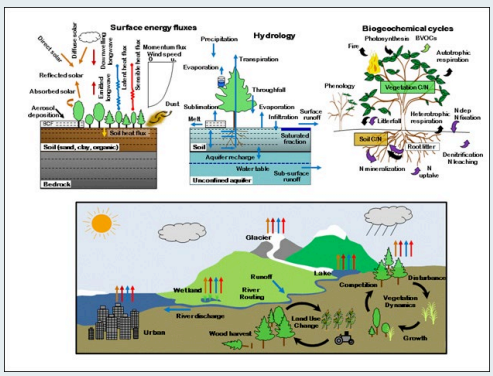


Groundwater basins and classification in CA.

Technological Challenges

Uncertainty in the amount of available surface water leads to uncertainty in the amount of required groundwater. In order to quantify the amount of available groundwater in the future, we have to make predictions for many different future climate scenarios.

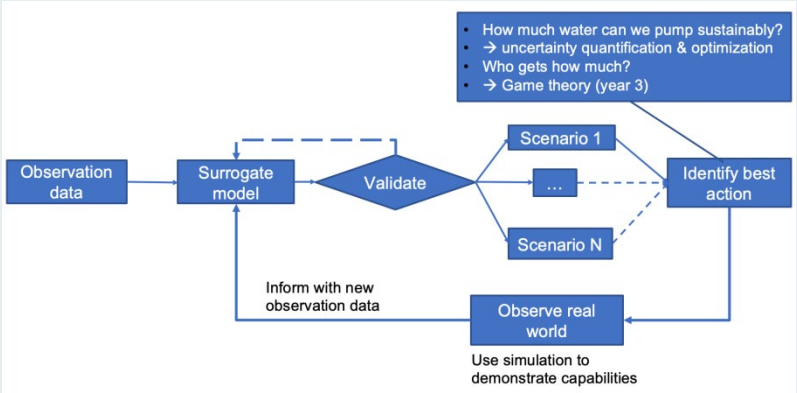
Simulations models based on physical process understanding are computationally too expensive and too hard to use for making these predictions for all possible future climate scenarios for all basins.



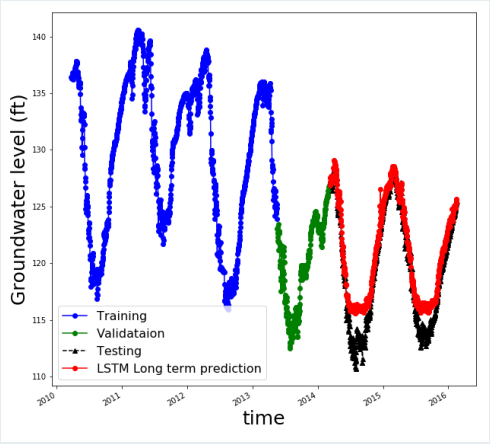
CLM modeling approach is shown.

Research

We are developing a computationally efficient decision support tool that can run on a laptop and that will enable groundwater managers to make timely decisions on how much water can be pumped sustainably. Our tool is purely data-informed. We train a machine learning model on historic observations such as temperature, precipitation, and groundwater levels. This takes only a few minutes as compared to process-based simulations that take several hours. We use our model to make groundwater level predictions for several future climate scenarios. Optimization and uncertainty quantification will enable us to identify the best groundwater pumping action that will comply with SGMA regulations. Since our machine learning model is so fast to train, we update it with new observation data, which allows us to make groundwater management decisions on any desired time scale.



Flowchart of our groundwater management support tool.



Long term predictions of groundwater levels with our tool (red) compared to true data (black).

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