California Groundwater Resources (2000 – 2050)

Subject: Re: Groundwater Technical Brief
To: Jonah
CC: Kent Davidson
From: Sophia Wilmore
Date: November 24, 2020

Summary

This memo looks into California's groundwater resources over a 50-year period (2000 – 2050) assuming business as usual. Due to uncertainty surrounding the actual amount of initial groundwater storage from the year 2000, this memo includes a model of how changing amounts of initial groundwater storage affect the time to depletion. In each of the three models, regardless of initial storage, California's groundwater supply is spent by the year 2050. The data used to create these models are referenced from Curmi et al..

Introduction

In California, groundwater is a resource used primarily for vital production jobs such as agriculture and manufacturing. Like all resources, groundwater is in finite supply and must be sustainably managed to meet present and future demands. Addressing California's groundwater management, Governor Jerry Brown signed three bills into law in 2013, collectively named the Sustainable Groundwater Management Act (SGMA). These bills act as a framework for sustainable groundwater management in California. To better understand California's groundwater sustainability, this memo includes a model that can be used to predict future supply given business-as-usual usage from the year 2000. The model uses recharge and withdraw values from this starting year to assess the trend in groundwater depletion and does not estimate the impact of SGMA's implementation. The groundwater recharge, withdraw, and supply estimates used in this memo are referenced or calculated from Curmi et al.. The estimates given by Curmi et al. are dependent on the following assumptions for the year 2050: California's population will increase to 55 million people and 30% of California's urban and agricultural water demand will be supplied from groundwater.

Analysis and Figures

The model shown in **Fig. 1** predicts future groundwater supply under a business-as-usual scenario given an initial mean groundwater supply estimate of 350×10^9 m^3 from the year 2000. This figure shows exponential decay and signals that California will run out of groundwater by the year 2036 (the year before values become negative, as indicated by the dashed line at 0). Addressing uncertainty around the actual initial groundwater supply, **Fig. 2** models two additional initial groundwater supply estimates, 190×10^9 m^3 and 550×10^9 m^3, as compared to the mean value for groundwater supply. The two additional values were estimated using a 90% confidence interval[1]. For the estimate of 190×10^9 m^3 the model predicts groundwater depletion in 2023 and 2050 for the 550×10^9 m^3 estimate.

[1] Uncertainty surrounding the initial mean value (350×10^9 m^3) follows a normal distribution with a standard deviation of 115×10^9 m^3. Given this, a 90% confidence interval estimates a lower limit of 190×10^9 m^3 and an upper limit of 550×10^9 m^3.

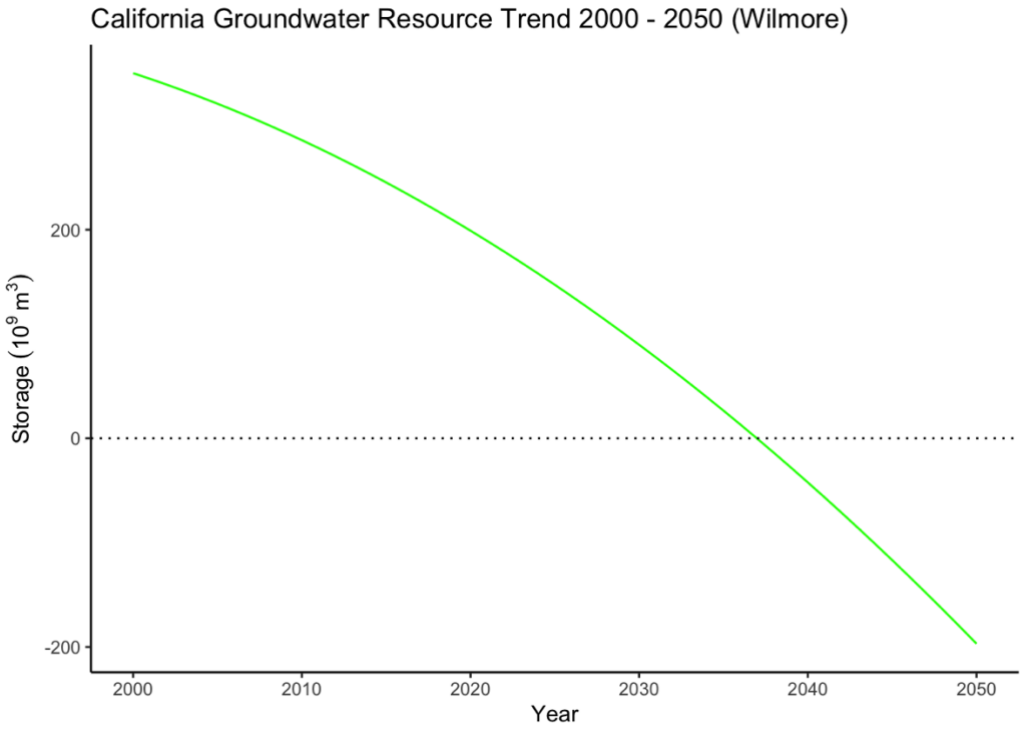

Fig. 1 Estimated change in California groundwater resources from an uncertain initial storage value of 350 x 10^9 m^3 from the year 2000; horizontal line indicates year of depletion (2036)

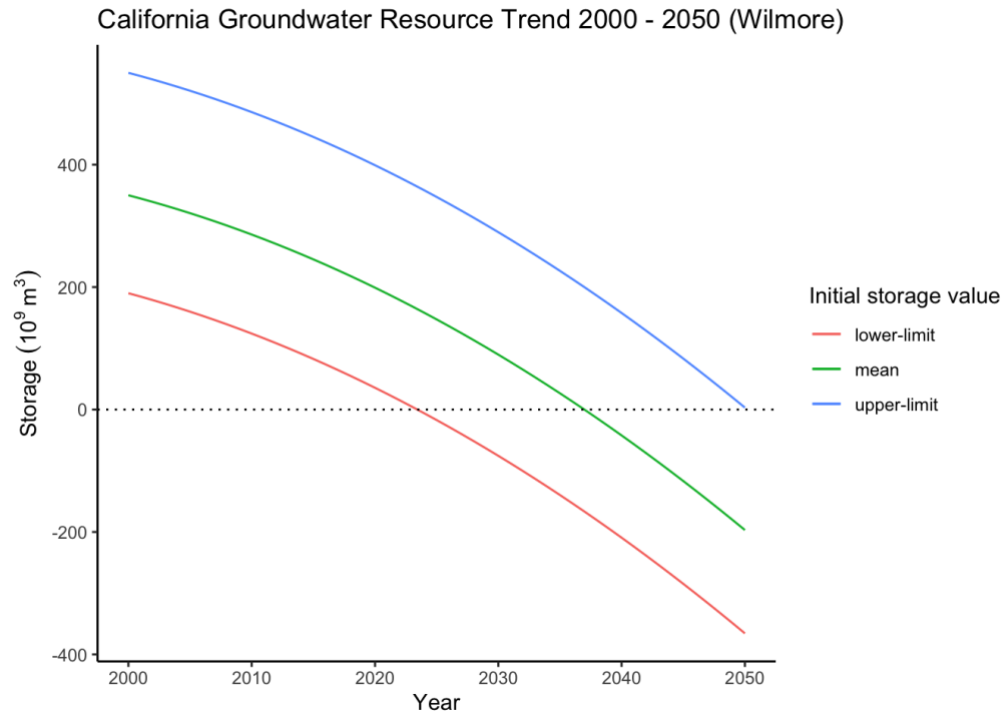

Fig. 2 Estimated change in California groundwater supply from an uncertain initial mean storage value of 350 x 10^9 m^3 and the upper- (550 x 10^9 m^3) and lower- limits (190 x 10^9 m^3) of a 90% confidence interval[1] to address uncertainty in the actual initial groundwater supply; horizontal line indicates year of depletion (2050, 2036, and 2023 in order of the lines)

Conclusion

From the analysis, we can see that regardless of initial groundwater supply, business-as-usual trends from the year 2000 are unsustainable and will deplete California's groundwater resources before the year 2050. For the initial groundwater storage estimates of 190 x 10^9 m^3, 350 x 10^9, and 550 x 10^9 m^3 the year of total depletion is predicted in 2023, 2036, and 2050 respectively. To sustainably manage groundwater resources, California should reduce withdraws of groundwater below the rate of recharge. Recycling water and more efficiently managing water used for production such as agriculture and manufacturing should be considered as possible options for reducing California's withdraws. Additionally, SGMA should be considered a vital framework for sustainable groundwater management. To further analyze the demands and availability of California's groundwater supply, a more accurate measure of initial groundwater supply is needed.

Works Cited

Curmi, Elizabeth, et al. "Visualising a Stochastic Model of Californian Water Resources Using Sankey Diagrams." *Water Resources Management*, 2013, pp. 3035–3050., doi:10.1007/s11269-013-0331-2.