Irrigation Impacts on Future Groundwater Levels in the Kansas River Alluvial Aquifer

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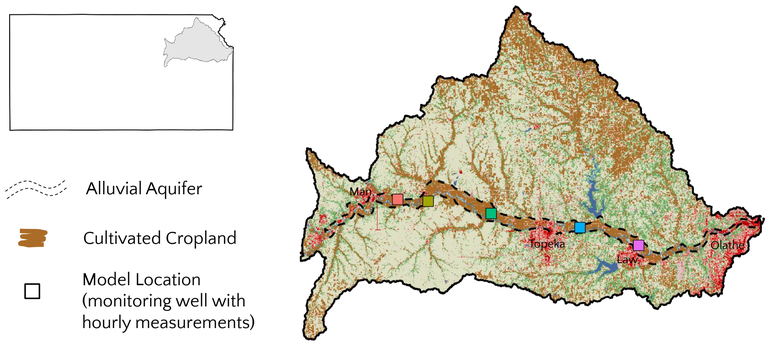
Problem and Research Questions

In the coming decades, irrigated agriculture may expand across the Kansas River Alluvial Aquifer as an adaptation to an aridifying climate.



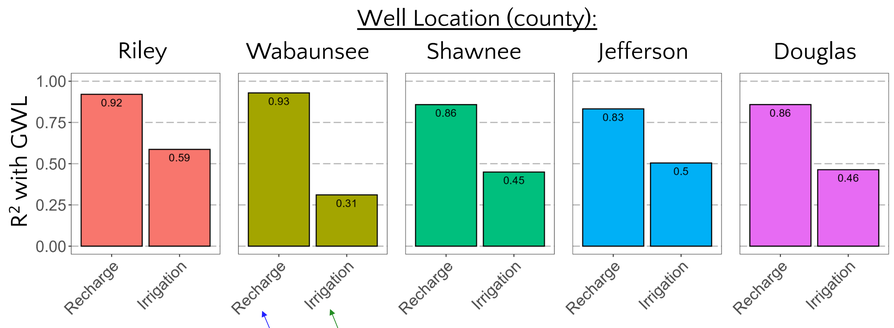
We are studying how climatic conditions and irrigation activity influence groundwater levels across the aquifer in order to assess their potential future impacts on groundwater availability.

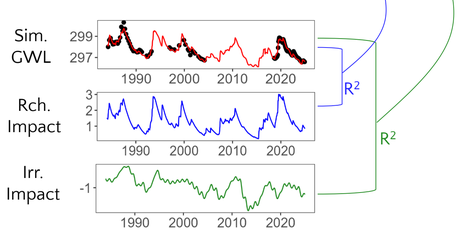
Questions

1. What is the impact of irrigation on groundwater levels across the aquifer?
2. How are groundwater levels projected to change in the coming decades under current irrigation strategies?

Q1: Impacts of Irrigation on Groundwater Levels

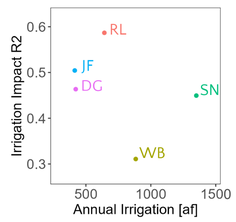
Models at 5 wells across the aquifer indicate that the influence of irrigation on groundwater levels (GWL) **varies by location** but is consistently **less than the influence of recharge:**



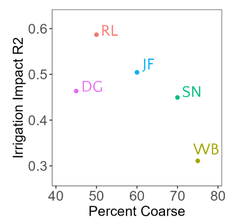


R^2 between simulated groundwater levels and driver impacts indicates the importance of that driver in determining groundwater levels

Irrigation impact is seemingly **not** related to the amount of irrigation that occurs nearby:



It instead seems to be related to **local geology**, with more conductive sediments reducing irrigation impact:

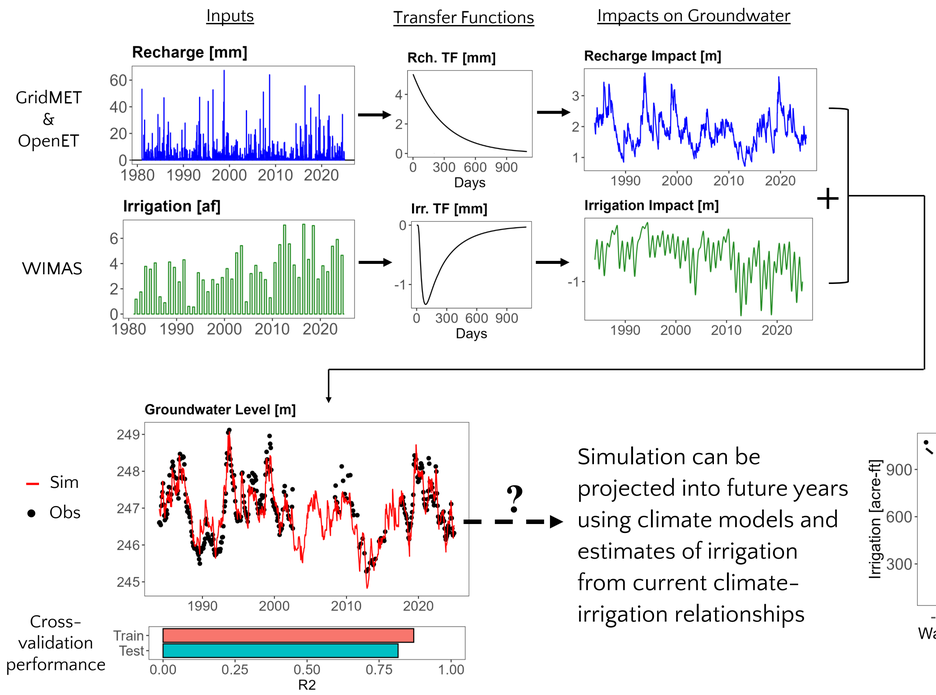


Takeaways

- Irrigation has a minor impact on groundwater levels relative to recharge, especially in areas with coarse sediment
- Future projections indicate no significant trends in groundwater levels in the coming decades
- Future declines in groundwater due to irrigation demand are balanced by increases in recharge
- Changes to current climate-irrigation relationships (e.g., from irrigation expansion) may alter this balance and change projected trends

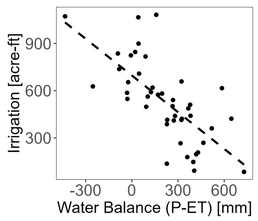
Methods: Transfer Function-Noise Models

Transfer function-noise models use calibrated **transfer functions** to transform input time series into their individual impacts on groundwater levels at a given well (data shown is for well in Douglas County):



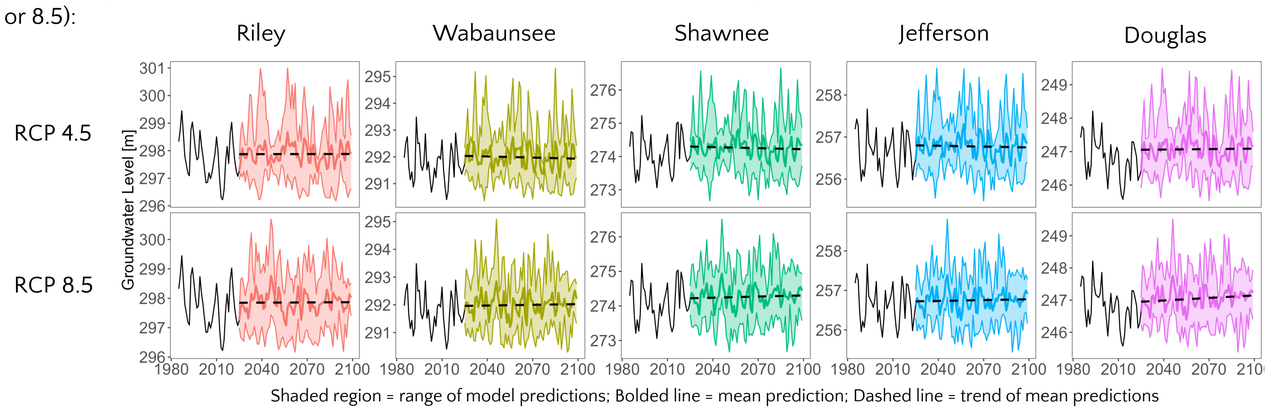
Input impacts are summed to get a simulation of groundwater levels

Simulation can be projected into future years using climate models and estimates of irrigation from current climate-irrigation relationships



Q2: Groundwater Level Projections

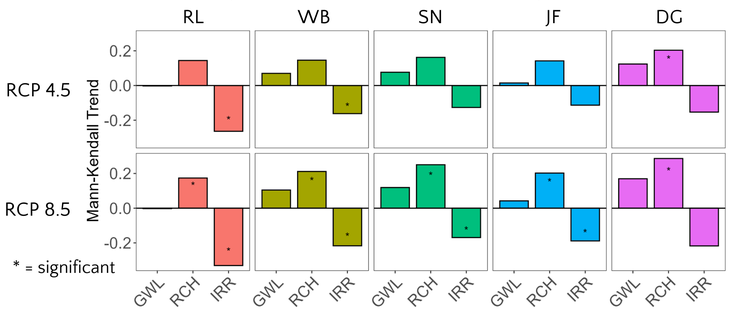
Using current climate-irrigation relationships and an ensemble of global climate models, **our groundwater models do not project significant trends in groundwater levels** over the next 75 years, regardless of location or climate scenario (RCP 4.5 or 8.5):



Shaded region = range of model predictions; Bolded line = mean prediction; Dashed line = trend of mean predictions

The non-significant trends in groundwater level (GWL) are produced by a **balance** of positive trends in recharge impacts (RCH) and negative trends in irrigation impacts (IRR):

If climate-irrigation relationships change from the current strategy simulated here (i.e., irrigation expansion), the balance **may** tip towards long-term decline.



* = significant