# Saturation Levels Over the Ogallala Aquifer in 2050: A Simple Model

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## Introduction

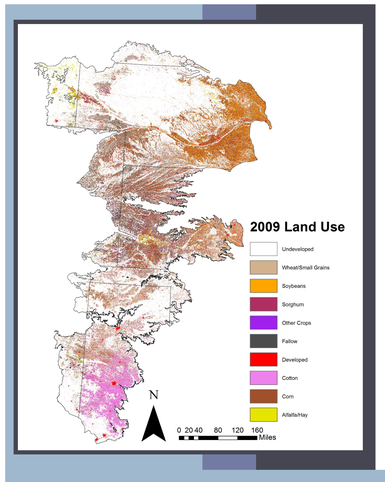
The Ogallala Aquifer, also known as the High Plains Aquifer, is one of America's greatest agricultural resources. It supplies groundwater used for the irrigation of about 30% of all the food produced in the United States and in some areas, is projected to be depleted beyond use by the year 2040.

This project was created with the sole intention of creating a simple model of the Ogallala Aquifer's saturation levels in 2050 by using the USGS (United States Geological Survey) data set 777. This data set contains annual irrigation, infiltration, and rainfall in 2009, saturation levels in 2009 and projected land use from 2009 to 2050.

This is a very simple model where only land use changes each year and many important variables related to aquifer dynamics are unaccounted for, which means that the values calculated from 2009 could easily be effected by unique environmental factors and any sort of water flow has been disregarded. In addition, some of the maps have dissimilar sample sizes, which could easily effect the legitimacy of the predictions of this model. The purpose is not to have accuracy in modeling, but demonstrate a simple model and see if the results are similar to other, more complex ones.

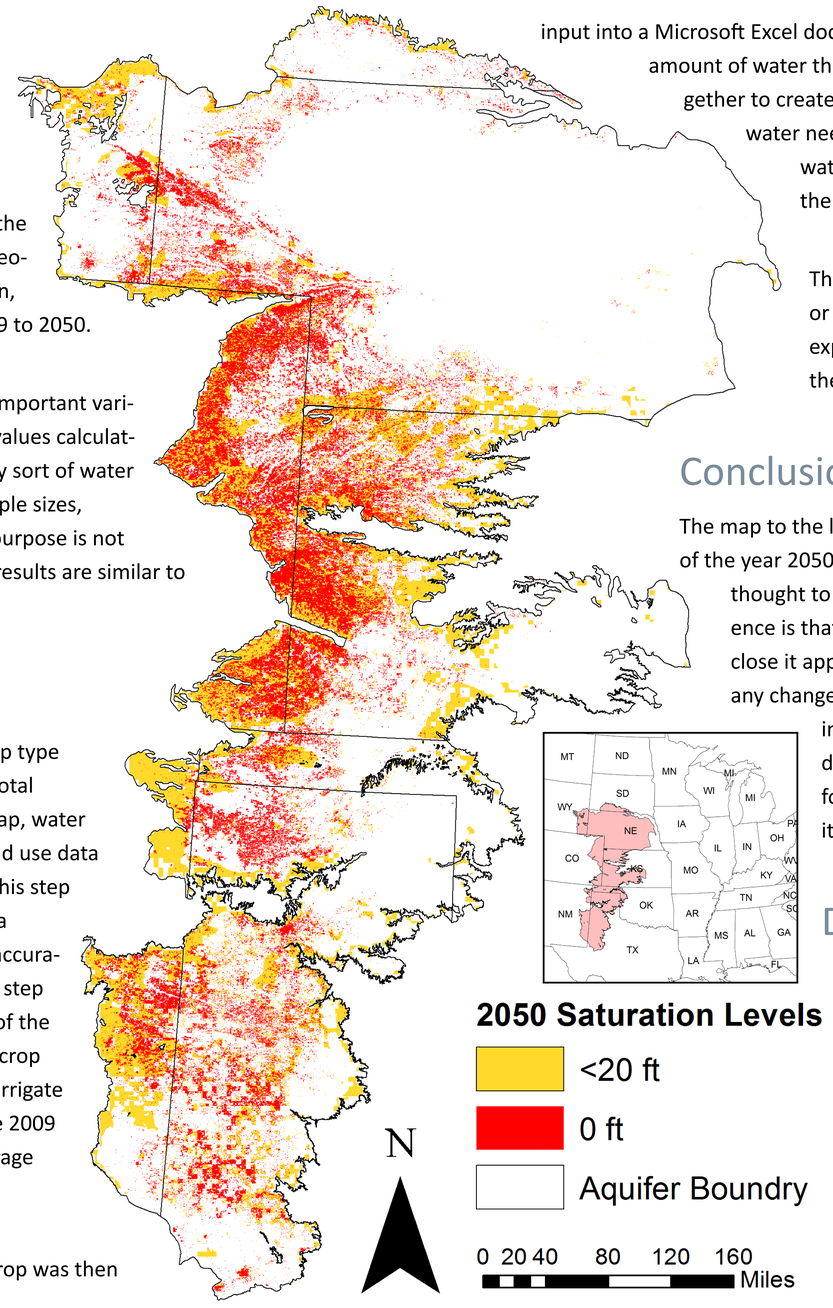
## Methods

The first step of this process was to find the average amount of water each crop type needs to grow. I added the rainfall and irrigation maps from 2009 to find the total amount of water that was put on the soil over the Ogallala. This new raster map, water need, was then resampled to the land use data sample size in order to do a mask. This step resampled the water need raster to a smaller cell size, likely effecting the accuracy of the extracted data, though this step was necessary to keep the integrity of the land use data. I did a mask for each crop type and a few other land uses that irrigate water (e.g. developed land) from the 2009 land use data and extracted the average water that fell on each crop.




The calculated water need of each crop was then input into a Microsoft Excel document and joined to each of the 42 projected land use maps (year 2009 to 2050) to gather the amount of water that would be required to grow crops each year over each plot of land. I then added these maps together to create a raster map detailing the total water need over the 42 years over each plot of land. This 42 year water need could then subtracted from the expected rainfall over the same time period to find how much water farms would have to irrigate to make sure that they met the needs of their crops. This map is the projected total irrigation need (water being extracted from the aquifer) over those 42 years.

The last step in finding the modeled change in saturation level is to subtract the expected infiltration, or water entering the aquifer, over the 42 years to the amount being extracted. This raster map is the expected negative change, or reduction in saturation level of the Ogallala Aquifer, over the 42 years. I then added this map to the 2009 saturation levels to find the predicted 2050 saturation levels.




## Conclusion

The map to the left details the expected areas that will have no water left in the aquifer or sub 20 feet by the end of the year 2050. Not only do the results of my simple model look like other, more complex models, but the areas thought to be most affected by aquifer depletion are also most greatly affected in this map. The largest difference is that depletion in the north is much less pronounced in scientific models compared to mine. However close it appears to follow other maps, it is still important to keep in mind that this model failed to account for any changes due to climate, water flow or farmer behavior because of loss of water. Likely, legislation will be implemented in this region when aquifer depletion becomes apparent and this trend will be reduced compared to the extreme effects found here. The Ogallala Aquifer is an important resource for the farmers of the High Plains and it should be protected even before it becomes apparent that it is being depleted past use.

## Data Source


Houston, N.A., Gonzales-Bradford, S.L., Flynn, A.T., Qi, S.L., Peterson, S.M., Stanton, J.S., Ryter, D.W., Sohl, T.L., and Senay, G.B. (2013). "Geodatabase Compilation of Hydrogeologic, Remote Sensing, and Water-Budget-Component Data for the High Plains Aquifer" U.S. Geological Survey, Data Series 777


## Map Projection

Albers Conical Equal Area


CEE 186: Introduction to Geographical Information Systems

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