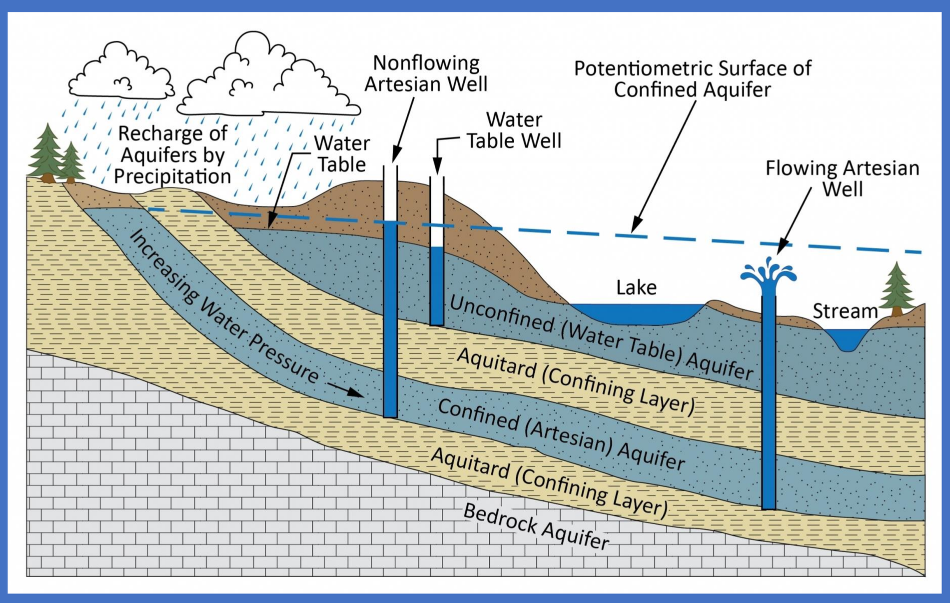
Constructing a 3D Model of the Dakota Aquifer System, a Digital Tool for Future Scientific Study



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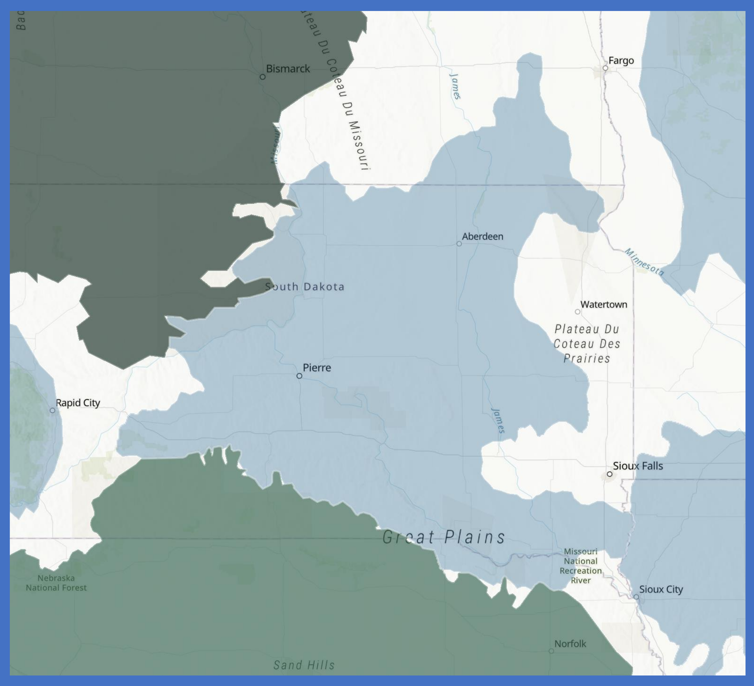


Abstract

Groundwater represents a significant portion of the world's water that is suitable for human consumption and plays an important role in supporting agriculture and food production. Studies have shown that most groundwater extracted for human use is being withdrawn at levels that cannot be sustained. Understanding the hydrogeology of aquifers is critical to groundwater management, but 3D hydrogeologic models of aquifer systems are limited, even where lithological information is available. Here we create a 3D hydrogeologic model of the Dakota aquifer system of South Dakota. We use lithological logs from groundwater wells drilled throughout the state to construct hydrogeologic layers of the aquifer system. We completed a 3D spatial rendering of several aquifer units within the Dakota aquifer system which represent important sources of groundwater in the state. South Dakota relies on groundwater to support its economy and the majority of the state's residents use groundwater as their primary water source. Our model of these aquifer units represents a starting point for future research on the Dakota aquifer system, including detailed hydrologic models that may estimate groundwater flows. These models allow us to better visualize and quantify groundwater to promote sustainable water management.

Background

Groundwater:

- 98.4% of freshwater that is not frozen
- Source of drinking water for roughly 50% of the global population
- 43% of irrigation water globally

In South Dakota:

- 52% of public drinking systems dependent
- 74% of residents use it as their primary drinking source

Effects of Poor Groundwater Management:

- Groundwater depletion
- Land Subsidence
- Sea level rise
- Increase in pumping energy costs
- Water availability

Experimental Methods and Data

Data Collection

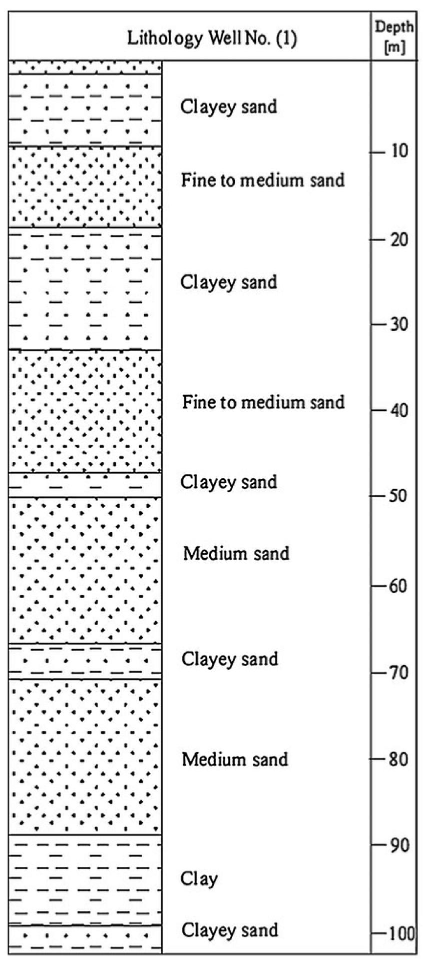
- Lithological logs data collected from wells drilled in South Dakota

Quality Control – RStudio

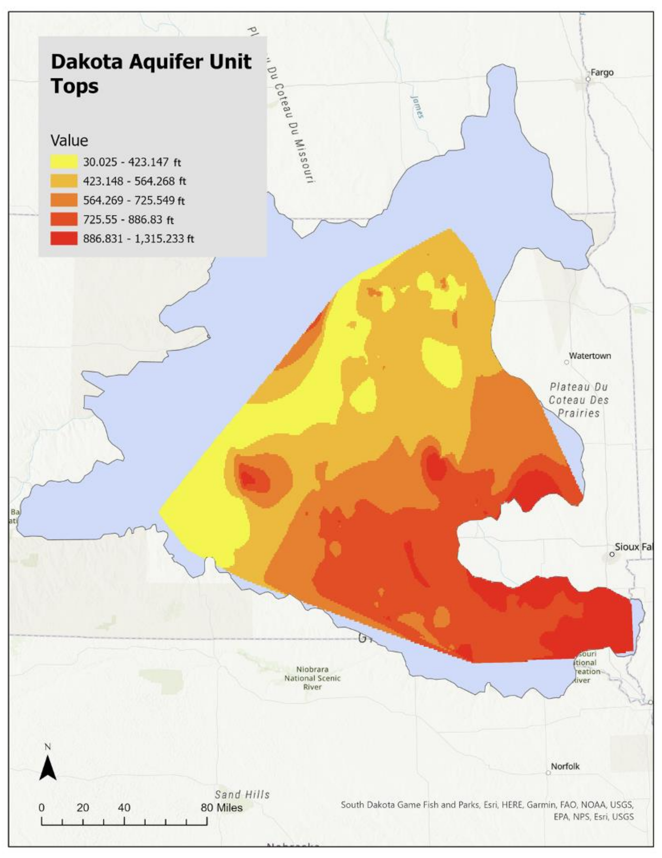
- Designating aquifer units
- Identifying layer depths
- Ensuring accuracy

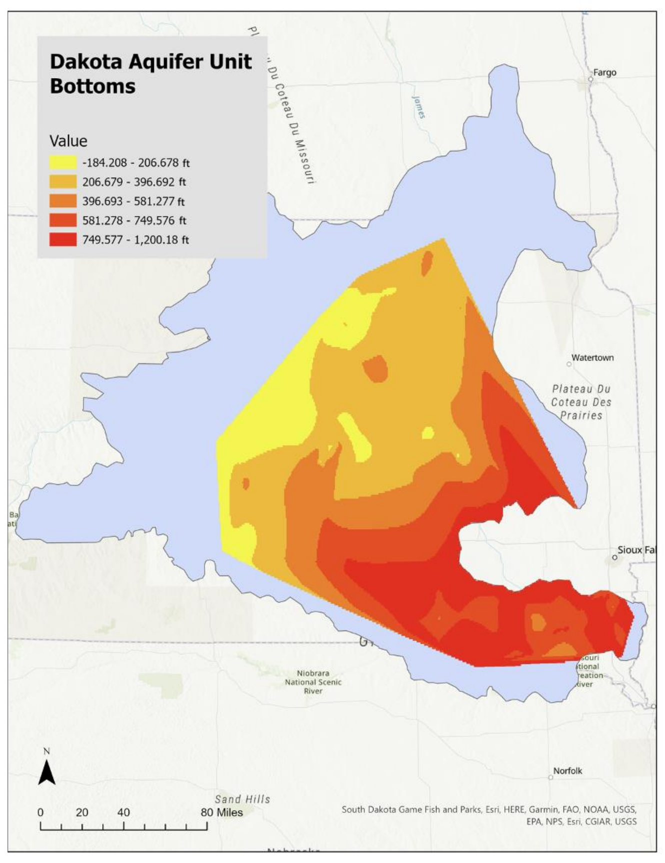
Modeling – ArcGIS Pro

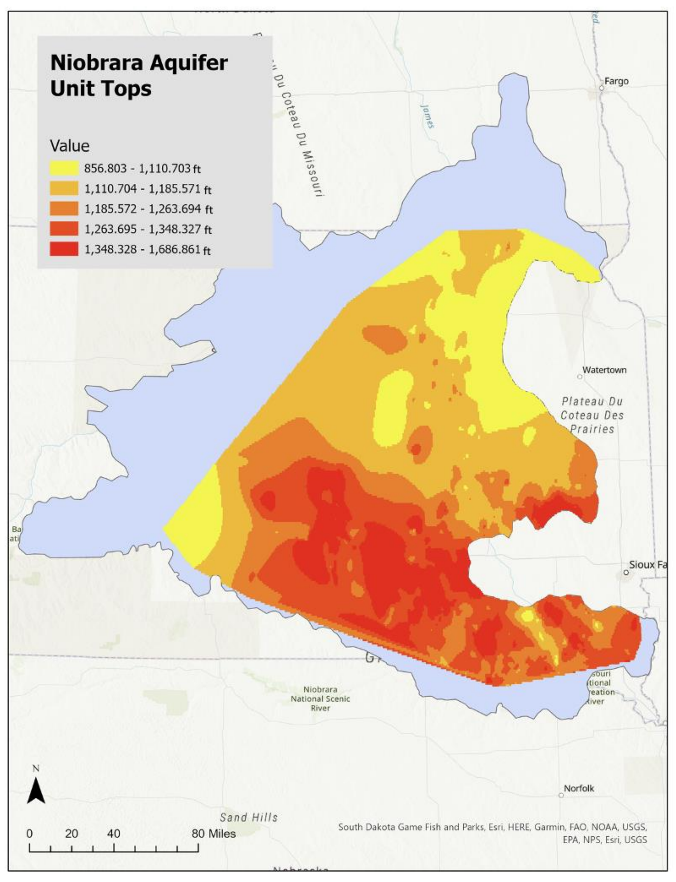
- Spatial analysis of well locations
- Removal of outliers
- Data extrapolation
- 3D modeling

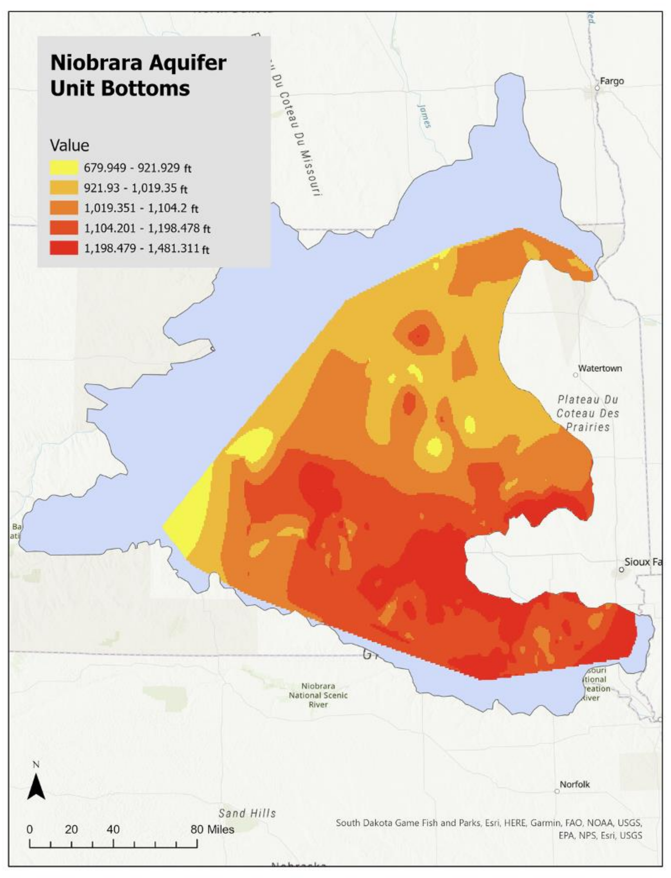


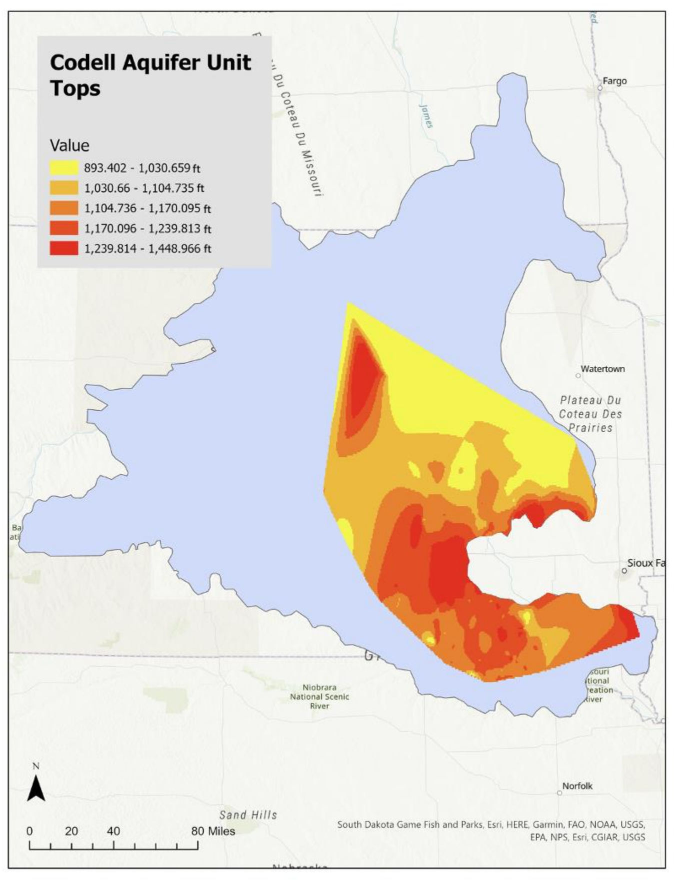
3D Hydrogeologic Models

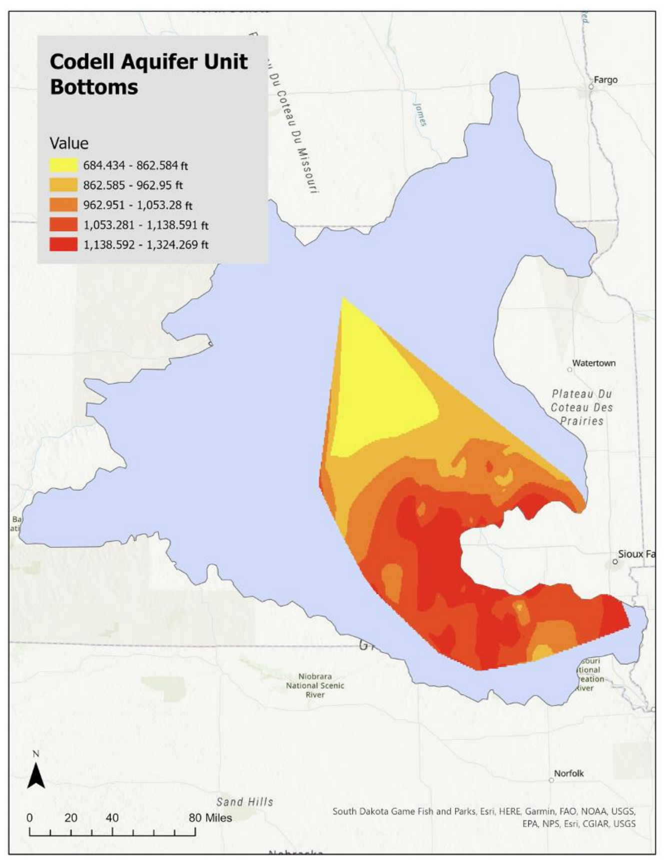












Detailed 3D Hydrologic Model

- Estimates of groundwater flow
- Identifying areas of recharge and discharge
- Identifying areas vulnerable to contamination
- Estimates of leakage through the confining layers
- Effects of climate

Want to know more about this study?

Please contact us!
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Acknowledgments

Jasechko Lab Group
CSEP
EUREKA!