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Quantifying the Impact of Eastern Red Cedar Encroachment on Recharge in the Nebraska Sandhills

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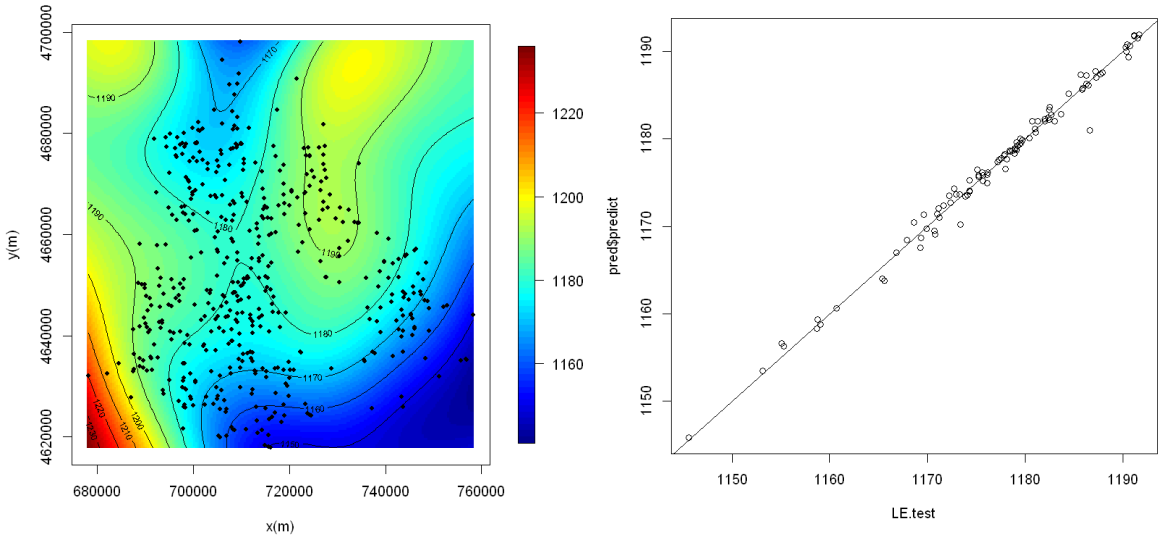
A lot has been accomplished in the last year. One student is working on gathering data to improve our understanding of the Sand Hills hydrology and improve our model inputs. The other student is focused on the modeling. The first model is set up and we will be simulating the impact of Red Cedar this next year. Below are details of their accomplishments this year and future work. We intend to expend the complete budget by December 2021. We expect the project benefits to be the same and are excited about determining the model outputs and its impact on water resources in the Sand Hills.

Work Accomplished from PhD student working on collected data for model inputs

- Submitted manuscript to Journal of Hydrology on "*Effects of drought on groundwater-fed lake areas in the Nebraska Sand Hills"*
- Presented a conference paper "Exploring Hypothetical Correlation between Drought and Lake Area of Groundwater-Fed Lakes in Western Sand Hills" at American Geophysical Union annual meet 2019 in San Francisco, CA

Current Work

- Mapping spatial variability in the ground water in the Nebraska Sand Hills using lake surface elevation derived from LIDAR data
- Initial observation shows promising output using Ordinary Kriging method
- We are exploring Bayesian regression approach with covariates such as saturated aquifer thickness, precipitation, and temperature.



Future Work

- Predicting red cedar encroachment in the Nebraska Sand Hills using artificial neural network approach
- In this approach we will estimate the trends of red cedar encroachment from the past using satellite images
- The trends will then be combined with neural network to understand and predict the distribution of red cedar encroachment in the Nebraska Sand Hills

Summary of progress from PhD student focused on modeling:

The SWAT model setup for the Upper Middle Loop (within the Sand Hills Area) has been modified to include 37 subbasins and to match the actual stream in the study area to improve the model response to the actual situation. Multiple simulations have been conducted and major improvement in matching the actual with the simulated flow out was accomplished as seen in the following figure. This was accomplished through multiple scenarios proposed based on realistic values of soil, hydrological components of the study area. Relevant literature review was conducted to keep the model parameters within realistic ranges. A continuation of the effort shall be conducted to reduce the peaks and achieve the desired satisfactory outcome.

The Sand Hills is a challenge to model with SWAT, a surface water model; therefore, we are also creating a MODFLOW model. The MODFLOW model has been created for the area as well and is now being calibrated. The next steps will include incorporating the coupled SWAT-MODFLOW to improve the model response and capture realistic recharge, evapotranspiration and surface runoff simulations, then different redcedar scenarios can be applied to the SWAT model with higher confidence in order to examine its impact on the water levels in the study area.