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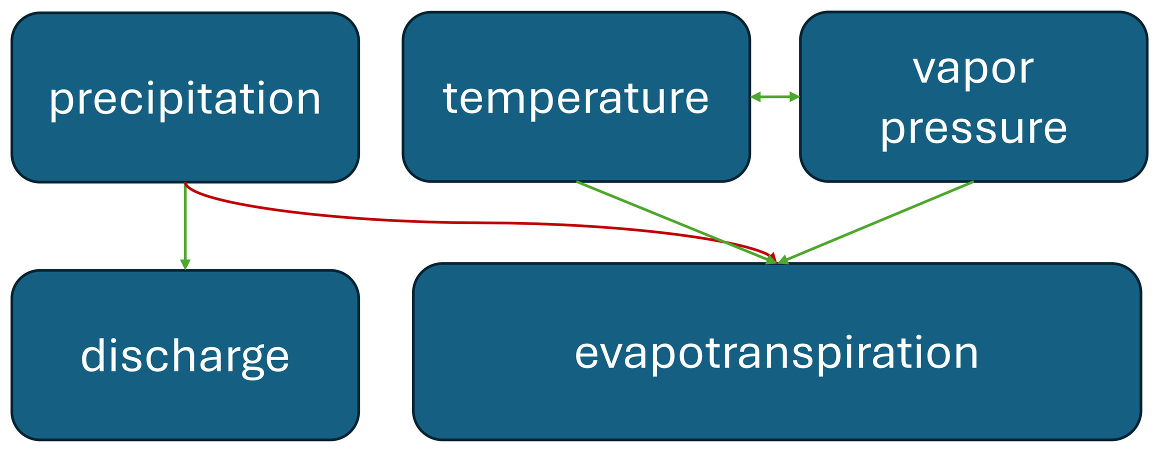
FORESTS & GLOBAL CHANGE LAB

# Patterns of Spring Discharge in a Texas Aquifer System

Springs have cycles of recharge, but no consistently predictable seasonal changes or trends. Daily discharge is correlated with vapor pressure, temperature, and evapotranspiration on that day.

## Background

Groundwater is vital to Texas' water supply, and climate change and increasing demand for water have an impact on spring discharge.




## Research Questions

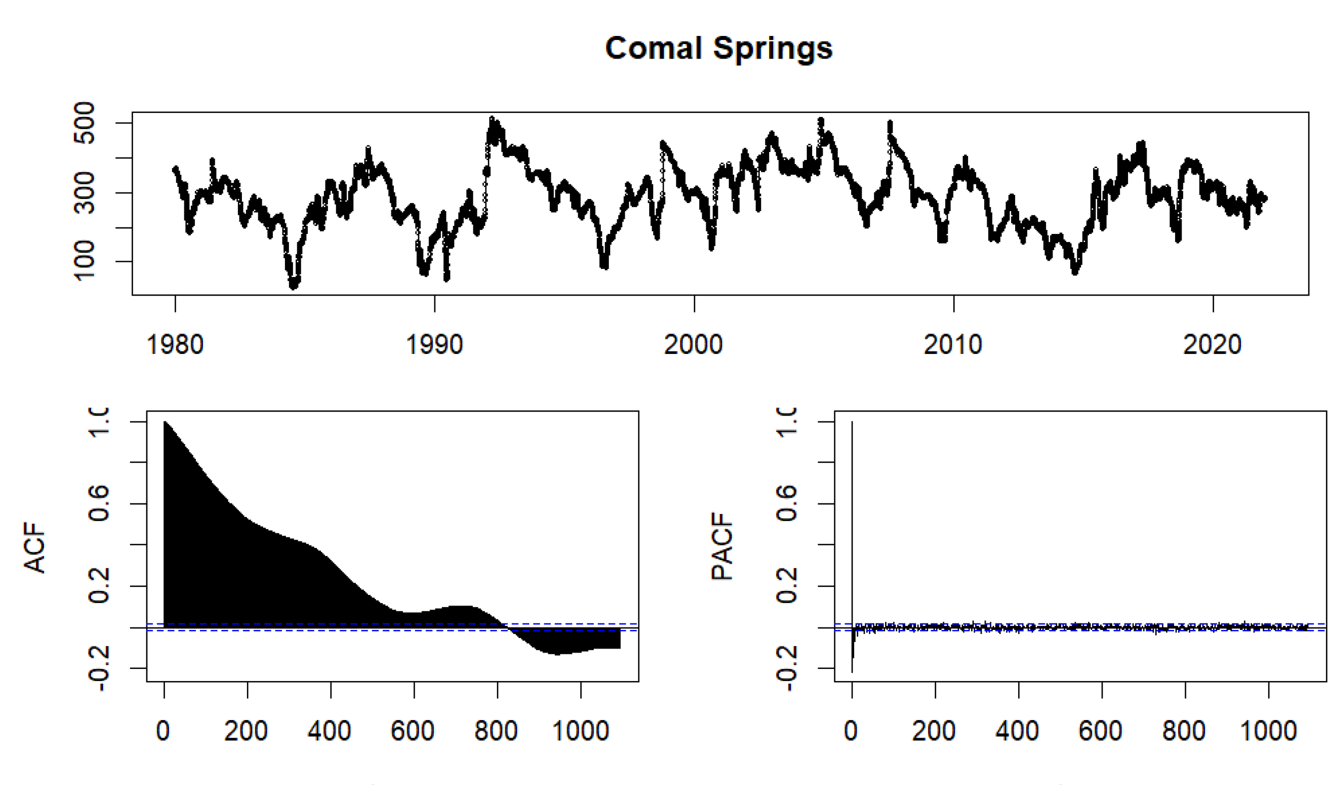
- What are the temporal trends in spring discharge across the state and for each site?
- Can satellite imagery be used to predict spring discharge?

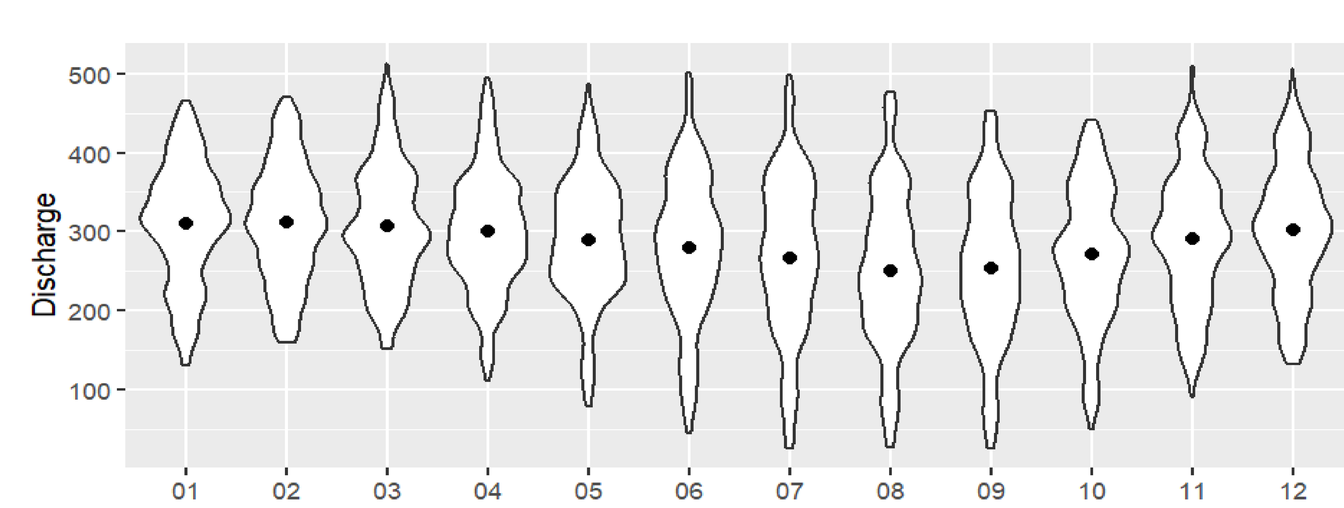
## Methods

- Time series analysis of trends in discharge
  - autocorrelation
  - ARIMA
  - ARIMAX
- Linear, lasso, elastic net, ridge regressions to determine how vapor pressure, temperature, evapotranspiration, and precipitation predict discharge
- VAR model to examine relationships between springs

With special thanks to the QAC and Professor Maryam Gooyabadi

## Results



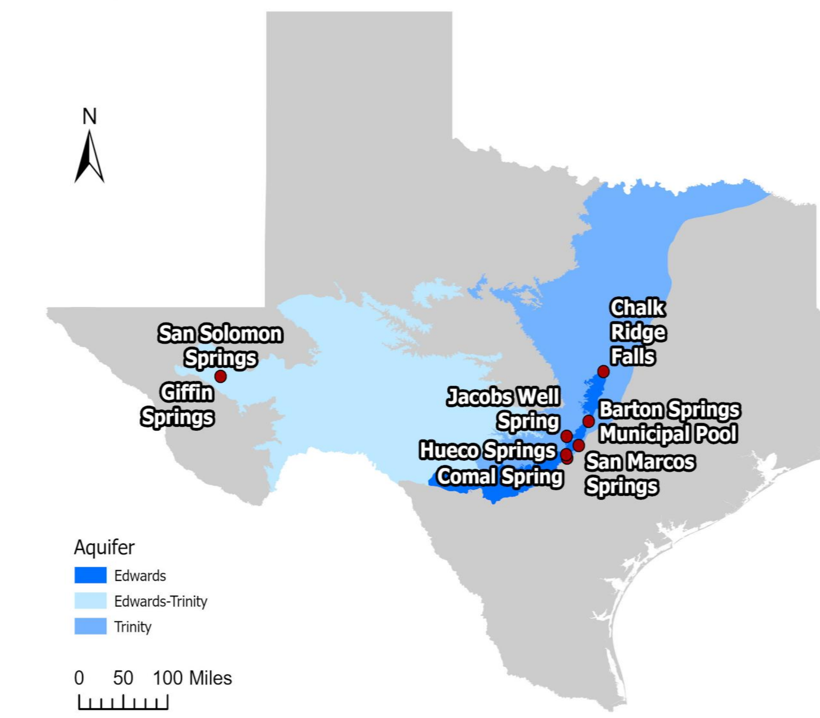



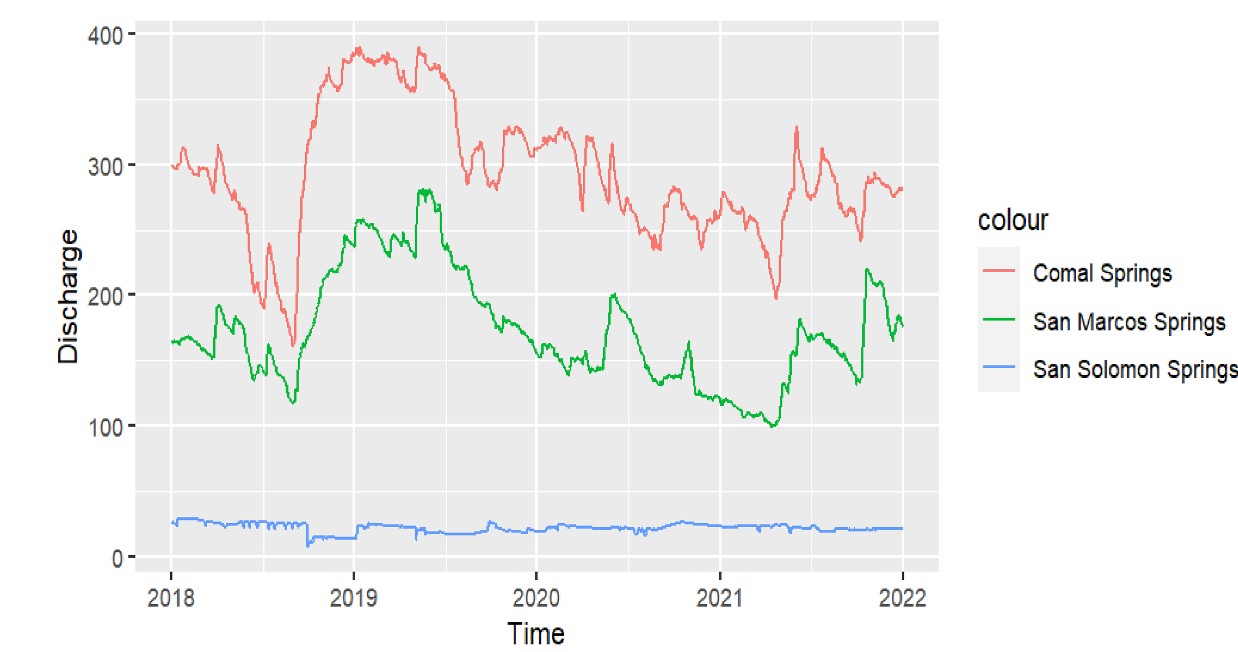

| Model | MSE | MAE | R2 | AIC |
|---|---|---|---|---|
| Ridge | 2040 | 35.9 | 0.174 | 3218 |
| Lasso | 2049 | 36.1 | 0.168 | 3220 |
| Elastic Net | 2049 | 36.1 | 0.168 | 3220 |

| Variable | Ridge | Lasso | Elastic Net |
|---|---|---|---|
| PT-JPL ET | 2.06 | 2.08 | 2.09 |
| Precip | -1.54 | -1.71 | -1.72 |
| Max Temp | -19.5 | -20.0 | -20.0 |
| Min Temp | -9.61 | -13.8 | -13.9 |
| Vapor Pressure | 15.1 | 19.9 | 20.0 |

## Discussion

As no model could explain variance across all springs, springs were modeled individually. Springs closer to each other behaved more similarly.




Spring discharge has a cyclical pattern that isn't solely explained by season.

The elastic net, ridge, and lasso regressions performed better than ARIMA and ARIMAX, with much lower AICs.

Between elastic net, ridge, and lasso, there was no significant difference in fit, and all three showed that daily vapor pressure and maximum temperature had the most effect on discharge.