Watershed storage parameters improve streamflow estimation accuracy for ungaged watersheds for a semiarid region of the Northern Great Plains, USA

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Research Motivation

- **Better streamflow estimates** are needed for hydrologic studies on Tribal lands.
- **Watershed storages** may provide *useful metrics* to improve streamflow estimates.
- **Modeling** watershed storage is necessary because *storages vary in time and space*.
- **Top-down modeling approaches** may accurately *classify watersheds* for regional pooling and identify key hydrologic landscape parameters.

“Finding your bug is a process of confirming the many things that you believe are true — until you find one which is not true.”

– Norm Matloff (describing computer programming)

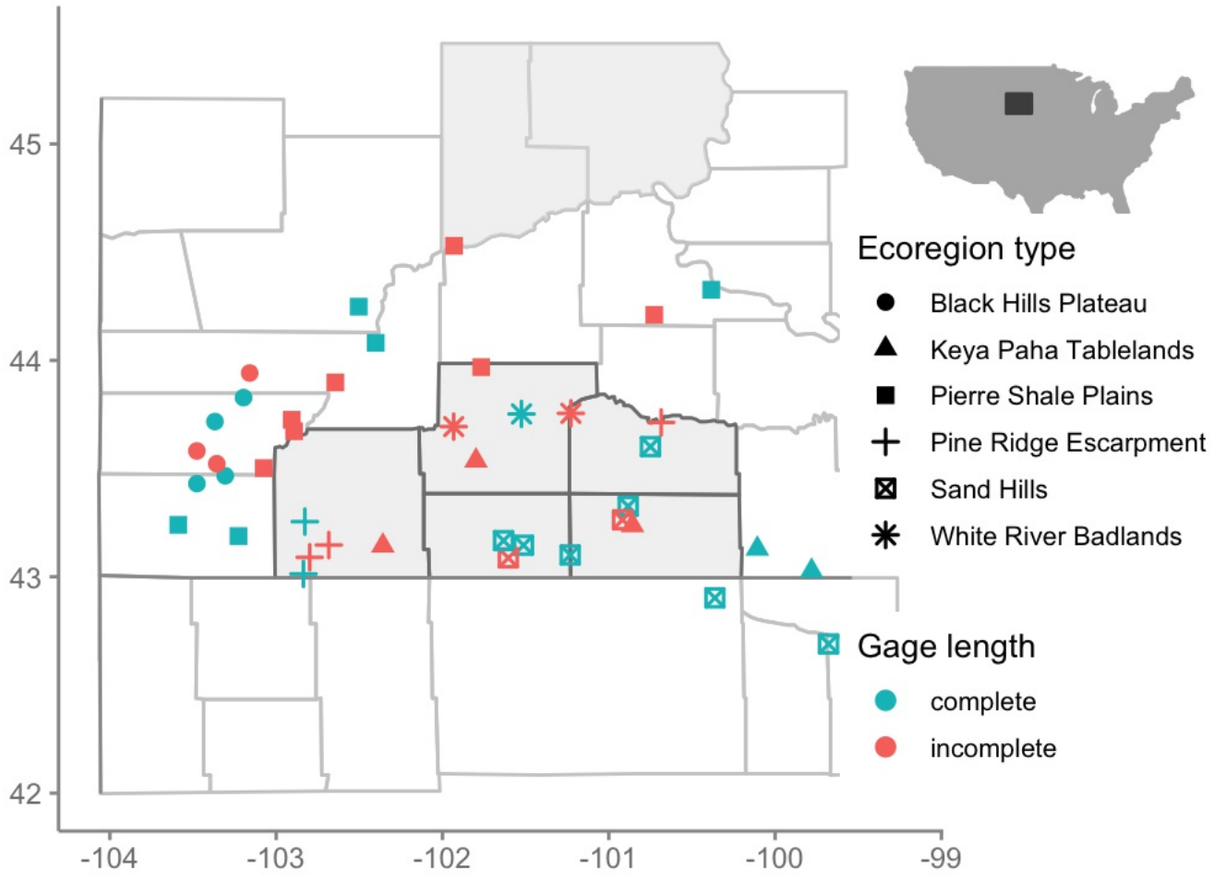
Overview

Outline

- Study Area Description
- Methods
- Results
- Key Findings
- Next Steps

Study Area Description

- SW South Dakota and NW Nebraska - semi-arid mid-latitude climate (BSk) – wet spring, hot summer, dry cold winter.
- USGS streamflow gages (N = 42) for water years 1980-2018 in non-karstic sedimentary watersheds without dams.



Classification Methods

- Log-transformed daily (q1), 7-day (q7) and 30-day (q30) flow depths
- Unsupervised classification using a finite mixture model (Fraley 2016).
- Bias-corrected and accelerated bootstrapping by ecoregion (DiCiccio, Thomas, and Bradley Efron, 1996).

Hydrologic landscape parameter development and hypothesis testing

- GIS–derived metrics following the hydrologic landscape conceptual framework (Winter 2001, Epting et al. 2018).
- GLM inputs are watershed zonal statistics (N = 15), plus seasonality, trend, and ecoregion type.
- Generalized Linear Models (GLMs) trained with 80/20 splits and 5-fold cross-validation. **q1 are response variables**, and **hydrologic landscape metrics are explanatory variables**.
- Selected GLM model, fitted holdout data, and evaluated against null models of mean daily flow depths.

Results and Discussion

Unsupervised Classification

- X-axis is hydrologic export and Y-axis is evenness (q30 - q1)
- Classification algorithm classified by streamflow by type, where:
- Type 1 flow is a zero flow and type 9 flow is a high-flow
- Note: orientation of types - low flows are relate to q1 & q7 and high flows relate to q30
- *Lots of overlap among ecoregions*, but