Sediment fingerprinting as a tool for identifying sources of erosion in Johnson County, Kansas

Maziyar Vaez Roudbari [1] and A. Husic[1]

1. Department of Civil, Environmental, and Architectural Engineering, University of Kansas

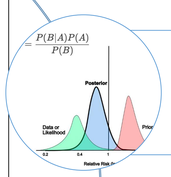
contact: m.vaez@ku.edu

INTRODUCTION

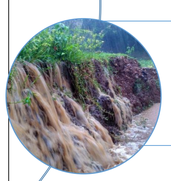
Anthropogenic activity over the last century has led to excess sediment erosion and negative impacts to aquatic ecosystems and water quality. In order to adequately manage and sustain landscapes, the key sources of sediment to rivers must be identified.

Sediment fingerprinting tools and geochemical tracers can be used to attribute how much of a river sediment mixture originates from various erosional sources. In this study, we will use a suite of geochemical tracers, including organics, metals, and radioisotopes, to investigate how urbanization impacts the sources of sediment to seven rivers.

RESEARCH OBJECTIVES



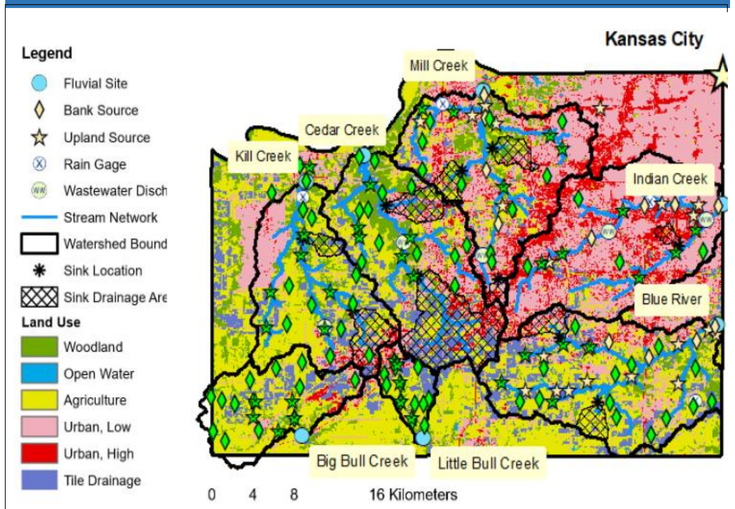
Build a numerical mixing model based on the statistical significance of transported sediment and sources.



Evaluate sediment sources in Johnson County, Kansas, by testing the numerical mixing model.

CONCEPTUAL AND FIELD LABORATORY INVESTIGATION

STUDY SITE



NUMERICAL MIXING MODEL

We use the following model to separate transported sediment to its two sources: upland surface erosion and subsurface streambank erosion.

$$X_U + X_b = 1 \quad (Equation\ 1)$$

$$C_U . X_U + C_b X_b = C_{mix} \quad (Equation\ 2)$$

Where X_U and X_b are the fractions of stream sediment from uplands and banks, respectively: C_U and C_b are the tracer signatures for upland and bank sources, respectively, and C_{mix} is the tracer signature in the transported sediment mixture.

RESULT

- In this study, 16 samples from Woodlands, 18 from Croplands, 25 from Residential, 33 from banks, and 24 from grassland were collected.
- Different tracers were evaluated included, organic (Carbon, Nitrogen) metals (28 Major/Minor/Trace Elements) and radioisotopes ($_{239+240}$ Pu)

CONCLUSIONS

Our 2019 dataset using a single radioisotope tracer shows that Bank sediment's contribution increases from 50% in the most rural basin to 93% in the most urban basin,

FUTURE STEPS

- Extend our fingerprinting model by the 2020-22 samples and to integrate additional tracers.
- Recommend best management practices (BMPs) to mitigate the negative impact of each source of sediments according to the fingerprinting model.

ACKNOWLEDGMENTS

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