Land Use Impacts on Dynamic Sediment Connectivity Across an Urbanizing Region

Isaac 'Zack' McVey[1], Admin Husic[1], Alexander Michalek[2], and Tyler Mahoney[3]
[1]Civil, Environmental, and Architectural Engineering, University of Kansas
[2]Civil and Environmental Engineering, University of Iowa
[3]Civil and Environmental Engineering, University of Louisville

INTRODUCTION

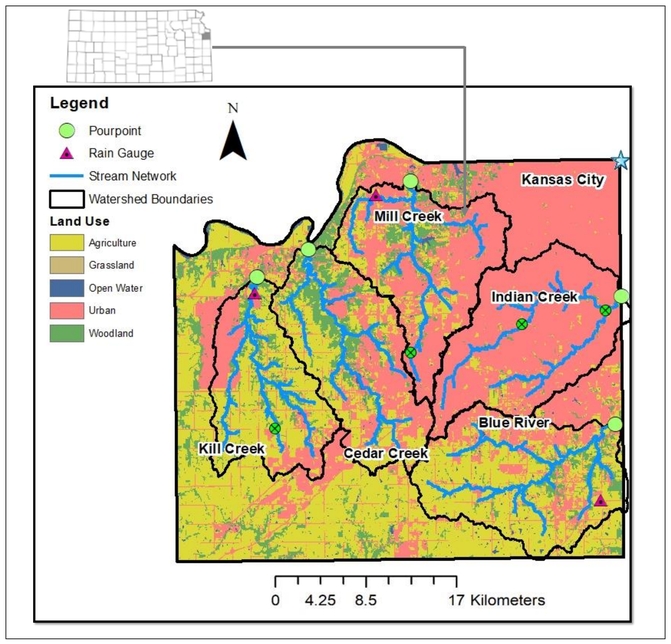
Sediment connectivity is the transfer of sediment between landscape components as a function of structural and dynamic watershed attributes. Recently connectivity theory has been defined as the intersecting probabilities of hydrologic and geomorphic processes such as sediment supply, erosion, sediment detachment, sediment transport, and (dis)connectivity. As natural and rural lands are urbanized to facilitate population growth, the impact of urbanization and sediment connectivity is unclear

The objective of this study to apply the probability of sediment connectivity to assess how changes in land use, such as urbanization, alters the probability of sediment connectivity.

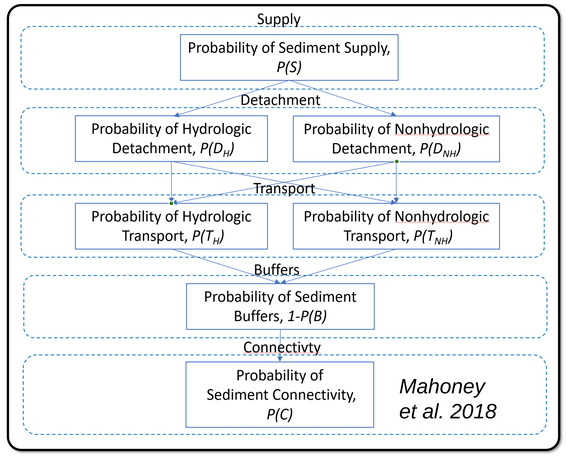
RESEARCH OBJECTIVES

1) Create physically-based hydrologic models to model dynamic watershed response for sediment connectivity
2) Apply Probability of Sediment Connectivity and Soil Water Assessment Tool (SWAT) to five watersheds with spanning urban land use.
3) Asses the impact of urbanization on sediment connectivity

STUDY SITE



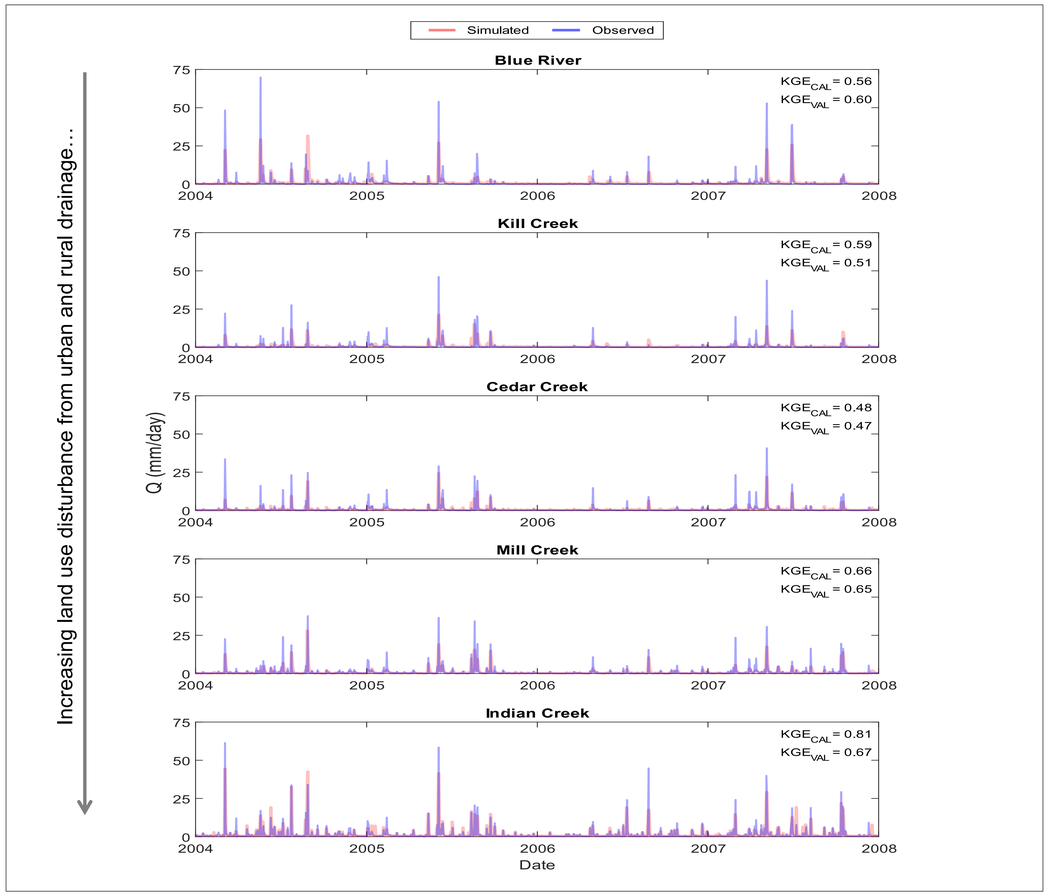
CONCEPTUAL MODEL



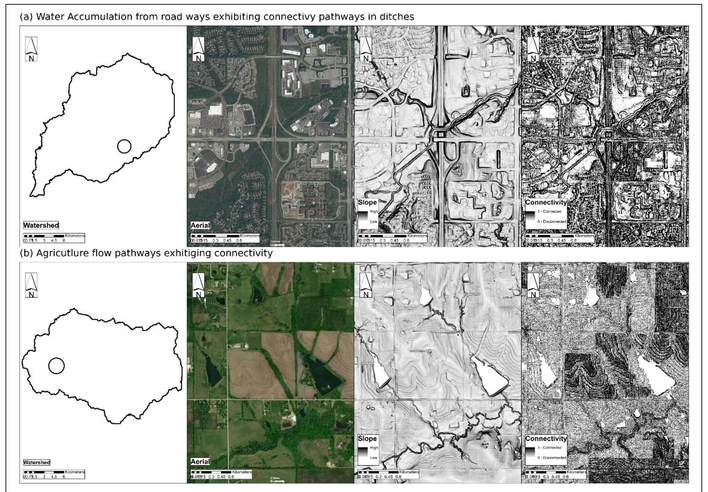
$$P(C) = P(S) \cap P(D_H \cup D_{NH}) \cap P(T_H \cup T_{NH}) \cap \{1 - P(B)\}$$

- Probability of sediment supply, ***P(S)***, indicates areas that are likely to be eroded.
- Probability of detachment, ***P(D)***, denotes if existing runoff provides enough shear to detach the exposed sediment.
- Probability of upstream and downstream transport, ***P(T)***, indicates if enough energy exists for transporting a detached particle based on soil moisture.
- Probability of buffers, ***P(B)***, indicates if a sediment discontinuity is present, e.g., buffer strips.

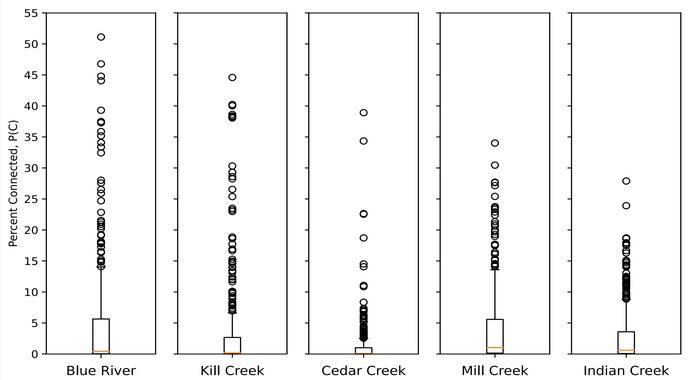
HYDROLOGIC MODEL RESULTS



SEDIMENT CONNECTIVITY RESULTS



Connectivity maps highlight where sediment connectivity is highest in Indian Creek along roadside ditches and stream banks. Streambanks in urban watersheds need most attention for erosion remediation. In agriculture heavy watersheds, steep hillslopes are prone to erosion and need great deal of attention.



P(C) boxplot illustrates that as urbanization increases, the wettest day of the year connects relatively less land (28% in Indian vs 51% in Blue) because sediment supply has been reduced by paved surfaces. On the other hand, the urban watersheds are more highly connected on a median (typical) day (0.7% vs 0.4%).

CONCLUSION

As our environment continues to urbanize it is of upmost importance to consider how land use change alters the probability of sediment connectivity and the implications of soil erosion in our watersheds.