Quantifying Runoff and Baseflow Controls on Stream Turbidity

Amirreza Zarnaghsh and Admin Husic
Department of Civil, Environmental, and Architectural Engineering, University of Kansas
contact: azarnaghsh@ku.edu

Introduction

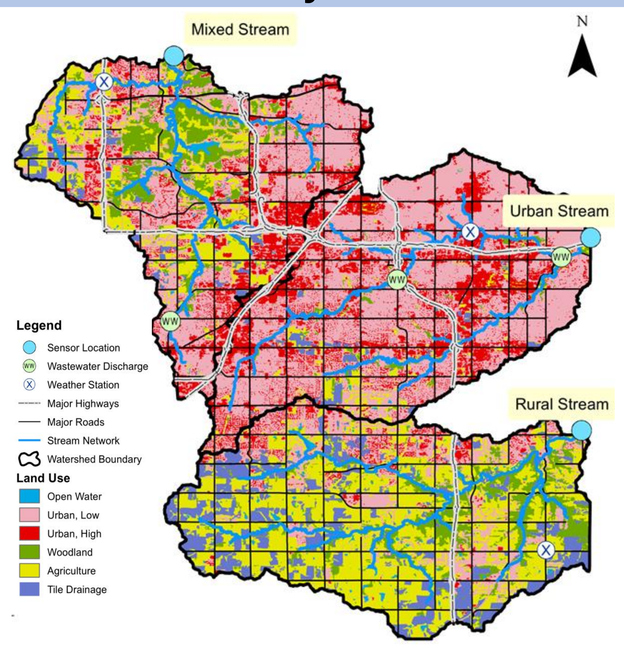
While suspended sediments are an indispensable part of streams and rivers, excess sediment can have long-term impacts on aquatic ecosystems health, hinder treatment of drinking water, and cause damage to infrastructure in urban areas. Storm events are key moments of sediment transport, when sediment concentrations can extremely increase over time scales as small as couple of hours. A major drawback in effective control of sediment pollution originates from the fact that the relative significance of storm water components as transporters of sediments to streams is highly uncertain, temporarily variable, and dependent to land-use and climatic conditions.

In this study, we coupled a hydrograph separation method with high-frequency turbidity data to explore the role of surface runoff and subsurface flow during 222 events from three watersheds in Johnson County, Kansas, between 2002 and 2014.

Research Objectives

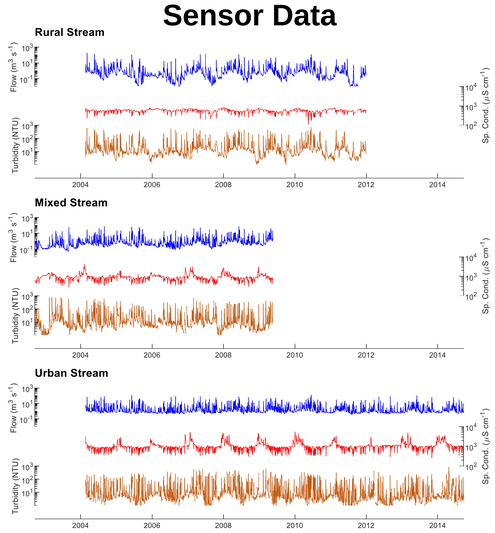
- ❑ Compare the importance of runoff vs. baseflow to turbidity generation across an urbanizing landscape
- ❑ Explore how storm characteristics and climatic conditions affect this significance in each watershed

Study Site

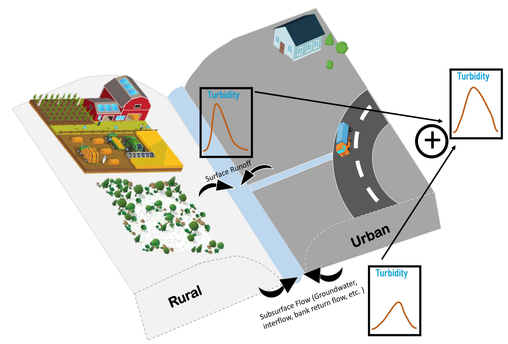


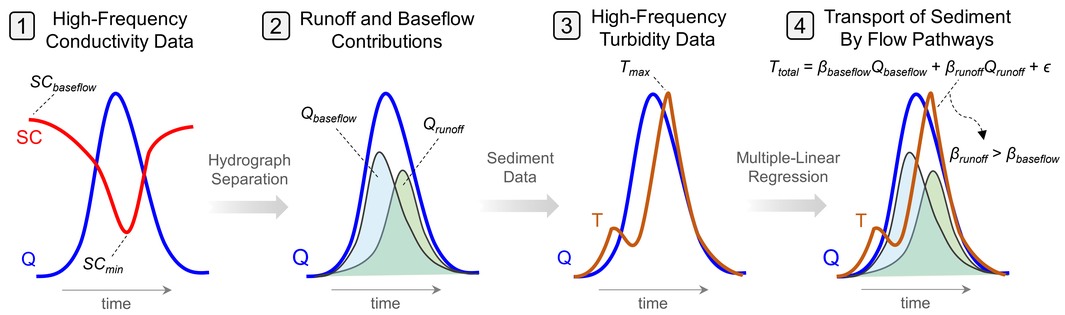
Conceptual Model and Methods

Sensor Data



Sediment Pathways

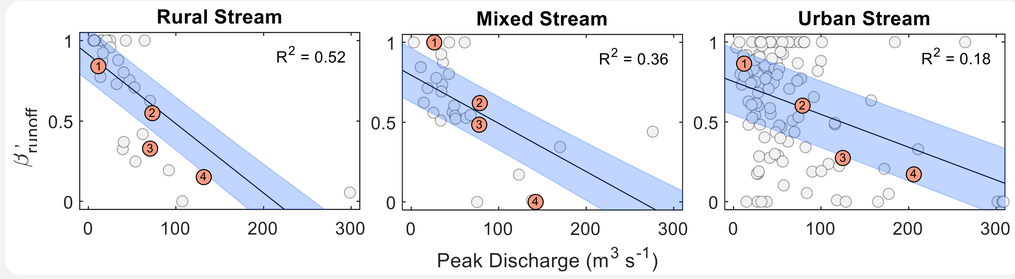




$$\beta'_{runoff} = \frac{\beta_{runoff}}{\beta_{runoff} + \beta_{baseflow}})$$

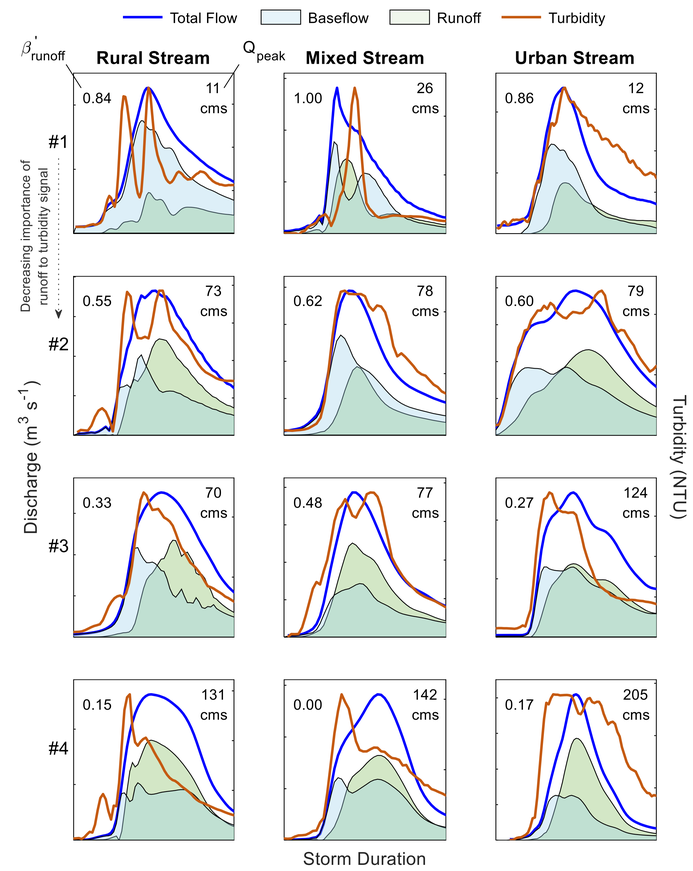
$\beta'_{runoff} = 0$ — Turbidity is fully aligned with baseflow → $\beta'_{runoff} = 1$ — Turbidity is fully aligned with runoff

Analysis Results



- ➢ As events intensify, baseflow becomes a more important driver in turbidity generation for the rural stream, but not the urban stream.
- ➢ Events in the urban basin are highly variable with respect to their driving mechanism and no clear relationship exists with discharge.

Sample Storm Events



- ➢ Turbidity generation in many events is dominated by either exclusive runoff or baseflow contribution.
- ➢ Dual turbidity peaks can be observed in many storm events indicating the contribution of both water components.

Conclusion