The heat is on: Predicting Urban Stream Temperature Responses to Summer Storms

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Abstract

Short-term surges in stream temperature in response to storm events have frequently been observed in urban areas , highlighting the need for improved understanding of the factors influencing urban stream temperature. Urban land cover complexity and infrastructure designed for rapid water routing to the sewer system create a direct link between storm events and water release processes, influencing urban stream temperature responses. This study aims to identify predictors of diverse stream temperature response patterns to summer storms. We analyzed 403 storm events from six urban and semi-urban catchments along the US East Coast using dynamic time warping to identify archetype patterns of stream temperature responses. We further disentangled observed stream temperature increase patterns to reveal the drivers associated with "heat pulses", which are characterized by a rapid but high-magnitude temperature increase followed by a sharp temperature drop at the start of the hydrograph. Our results show that stream temperature patterns were event-specific and linked to pre-event conditions and rainfall-runoff characteristics, with the shape of the hydrograph and rainfall-runoff response identified as the most important determinators of the observed temperature response patterns. Ponded surface waters and storm drains, as well as cooler water from the shallow subsurface, were identified as likely sources contributing to temperature patterns. These findings have important implications for understanding urban hydrology and the contributions of different source zones in urban catchments. Specifically, our results suggest that streamwater temperature can serve as a cost-effective tracer of information about urban water sources and pathways, aiding in the understanding of complex urban hydrology.

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