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A novel approach to characterising flow regimes in urban watersheds based on inter-amount times distribution

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Hydrological response in urban watersheds tends to be more flashy compared to natural watersheds as a result of the higher degree of imperviousness. Increase in flashiness is typically characterised by shorter response times to rainfall, higher runoff ratios and higher peak flows. Predicting the degree of flashiness is however not straightforward as it depends on the interplay of impervious cover, basin size and shape, soil properties, basin slope and, particularly for urban watersheds, drainage connectivity and control structures such as detention ponds, weirs and pumps.

One of the problems in analysing watershed response across different events and across different basins is that hydrological response variables need to be normalised for comparison. This is usually done by dividing instantaneous flows and cumulative flow volumes by basin area. The assumption underlying this approach is that the basin area homogeneously contributes to a base flow, on top of which effects related to contributions from impervious areas, basin slope, detention structures to flow variability can be superimposed.

In this paper we present an alternative approach of analysing hydrological flow variability that quantifies flashiness of basin response based on the distribution of inter-amount times. One of the advantages of this approach is that it allows comparison between basins without the need for normalising by basin area. Another advantage is that it can easily deal with variations in resolution of flow measurement as is often the case between periods of low flow (low measurement resolution) and high flow (high measurement resolution to capture peak flows).

In this study, we analyse flows measured at 18 gauges in the Charlotte watershed in North Carolina, US. Distribution of inter-amount times for a range of temporal resolutions will be presented and correlations with basin characteristics such as basin size, imperviousness degree, slope and flow control by detention ponds are investigated. As we will show, inter-amount times provide an elegant way of characterising flow regimes purely based on flow data.