EGU2020-4924
https://doi.org/10.5194/egusphere-egu2020-4924
EGU General Assembly 2020

A practical, objective, robust technique to directly estimate time of concentration

Giulia Giani, Miguel Angel Rico-Ramirez, and Ross Woods
University of Bristol, Water and Environmental Management Research Centre, Civil Engineering, Bristol, United Kingdom of Great Britain and Northern Ireland (gg16916@bristol.ac.uk)

Time of concentration is one of the key time variables in hydrology and it is essential for hydrograph design and hydrological modelling. Uncertainty in its estimation can cause errors in peak discharge rate and timing of flood events.

A unique recognized definition and methodology for its estimate is lacking and the multiple definitions and estimation procedures available in literature can give numerical prediction which can differ by up to 500% (Grimaldi et al., 2012). This result is not surprising given the high subjectivity of the traditionally used method to directly estimate time of concentration, also used for the calibration of the widely applied empirical formulae.

Given the importance of this time parameter in hydrology and the lack of a recognized and easily reproducible procedure for its estimate, here we propose a practical, objective, robust methodology to directly estimate time of concentration from rainfall and streamflow observations only. It's a timeseries analysis technique used already in the Economics field (Kristoufek, 2014), that have been adapted to estimate time of concentration.

Compared to the traditionally used method, which is event based and requires hyetograph and hydrograph separation, the proposed methodology is designed to find the time delay from the original continuous timeseries but can also be applied to individual events by creating a timeseries of copies of the same event.

In the first place, the median of time of concentration distribution with the proposed methodology has been evaluated against the one with the traditionally used one in 79 catchments across the UK, showing that in most of the sites estimates coming from the two methods are very similar (correlation value of 0.82). This means that it is possible to avoid the separation of the hydrograph, required by the traditionally used method, which is a highly subjective procedure.

Secondly, we show that, when considering the proposed methodology only, for each catchment the time of concentration estimate using the continuous timeseries has a small discrepancy compared to the median of the time of concentration distribution of the single events estimates (correlation value of 0.94). Therefore, rainfall-streamflow events selection is not necessary and a reliable estimate of time of concentration can be obtained by applying the proposed methodology

on the continuous timeseries at once, reducing the computational cost.

The proposed timeseries analysis technique is easy to automate, reproducible and make possible to objectively compare time of concentration estimates in all the catchments where the resolution of rainfall and streamflow timeseries is high enough to capture the runoff process.