



Adaptation of the concept of varying time of concentration within flood modelling: Theoretical and empirical investigations across the Mediterranean

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The time of concentration, t_c , is a key hydrological concept and often is an essential parameter of rainfall-runoff modelling, which has been traditionally tackled as a characteristic property of the river basin. However, both theoretical proof and empirical evidence imply that t_c is a hydraulic quantity that depends on flow, and thus it should be considered as variable and not as constant parameter. Using a kinematic method approach, easily implemented in GIS environment, we first illustrate that the relationship between t_c and the effective rainfall produced over the catchment is well-approximated by a power-type law, the exponent of which is associated with the slope of the longest flow path of the river basin. Next, we take advantage of this relationship to adapt the concept of varying time of concentration within flood modelling, and particularly the well-known SCS-CN approach. In this context, the initial abstraction ratio is also considered varying, while the propagation of the effective rainfall is employed through a parametric unit hydrograph, the shape of which is dynamically adjusted according to the runoff produced during the flood event. The above framework is tested in a number of Mediterranean river basins in Greece, Italy and Cyprus, ensuring faithful representation of most of the observed flood events. Based on the outcomes of this extended analysis, we provide guidance for employing this methodology for flood design studies in ungauged basins.