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Temporal disaggregation of daily rainfall data in SuDS design: a case study in Tuscany

Matteo Pampaloni et al.

Sustainable urban Drainage Systems (SuDS), by themselves or combined with grey traditional infrastructures, help to diminish the runoff volume and peak flow, as well as to improve the water quality. Hydrological design of SuDS is usually based on rainfall volumetric percentiles as the number of rainfall events, N_x, or the accumulated volume of the rainfall series, V_x, to be managed. Sub-index x refers to common qualities used in SuDS design, like 80, 85, 90 and 95%. Usually, only daily rainfall data are available. Nevertheless, due to the characteristics of the urban watershed involved in the SuDS implementation, the quantification of design parameters for these facilities needs sub-hourly rainfall time series. To overcome this issue, a temporal disaggregation methodology was proposed based on the use of a stochastic rainfall generator model (RainSim V3). We analysed the case of Florence University rain gauge (Tuscany, Italy), by collecting 20 years (in the period from 1998 to 2018) of observed data at 15 minutes time step. First, we verified the ability of RainSim model to reproduce observed rainfall patterns at 15 minutes time-step. The parameters of the stochastic model were estimated using observed data with 24 hours time-step. We generated 100 series of 20 years each with a time step of 15 minutes. We accounted two variables to implement the storm events extraction: a) the Minimum Inter-event Time (MIT) between storm events; 2) the storm volume threshold. We obtained a better characterization of the rainfall regime by applying the temporal disaggregation methodology than using daily-observed data. Second, we compared the SuDS design parameters N_x and V_x, obtained by using the stochastically generated rainfall, the observed daily and 15 minutes data. Moreover, the effect of different MITs and different thresholds on N_x and V_x were evaluated. In all the cases, results show that N_x and V_x obtained with the median of the simulated series were closer to the actual observed parameters based on 15 minutes time step than the ones calculated with the observed daily data. Therefore, the proposed temporal disaggregation method arises as an efficient technique to overcome the lack of sub-hourly rainfall data, necessary to adequately design SuDS.

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