



## **Towards assessing the impacts of large ground-mounted solar parks on the hydrological cycle: an analysis of runoff changes with EPA-SWMM software**

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Among all the renewable energy sources, solar photovoltaic (PV) is one of the most widespread in the world. Although solar energy is universally recognised as environmentally friendly energy source, impacts on surface hydrology of large parks have not been comprehensively addressed in literature. With growing concern over the impact of land use changes on stormwater runoff, the construction of large-scale solar power plants may face obstacles in the future unless appropriate quantification of this impact is addressed, and proper measures are taken to mitigate potential increment of flow peak and volume discharge. Assessment of runoff generation in PV solar parks can be carried out by modelling-based approaches, that have the advantage, with respect to purely experimental studies, to allow the investigation of the influence of different hydrological conditions. Moreover, the modelling-based approach enables the possibility to assess the park behavior in the short and in the long-term conditions. Analysis of the literature on the topic highlights a research gap consisting in the lack of a comprehensive tool for the assessment of the impacts of real-scale solar parks on stormwater runoff, by considering the hydrological processes occurring within the park and all the variables affecting the park response to precipitation events. In this work, we propose a novel conceptualization of PV solar parks response to precipitation events capitalizing on the use of the free and open-source Storm Water Management Model (SWMM). The conceptualization allows to take into account the complex hydrological process occurring in the solar parks during precipitation events and to assess how the process of runoff in the park is affected by the extension of the PV installation, soil properties and the characteristics of the rainfall events. Moreover, effects of long-term changes in roughness surface induced by the presence of the panels are taken into account in the analysis. We demonstrate the potentialities of the proposed approach considering a layout of the PV installation (panels size and inclination) as well as characteristics of the precipitation events that are encountered in Sicily (south Italy). In all the simulations, outflow discharge from the park is compared to that from a reference catchment to evaluate variations of peak flow and runoff volume. Results highlight no practical changes in runoff in the short term after installation. However, in the long term, modifications in soil cover may lead to some potential increase of runoff. For instance, increments of the peak flow from the solar park up to 21% and 35% are obtained for roughness coefficient reductions of 10% and 20%,

respectively. The proposed modelling approach can be beneficial for studying hydrological impacts of solar parks and thus for planning measures for their mitigation.