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Soil-water fluxes modelling in a green roof

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Green roofs differ from a natural environment as they are on top of a building and are not connected to the natural ground; therefore it is critical that soils can drain and retain water simultaneously and that they work even in very shallow systems. The soil or growing medium used for green roofs is specifically engineered to provide the vegetation with nutrients, discharging any excess water into the drainage layer, and releasing stored water back into the substrate. In this way, medium depth and porosity plays an important role in stormwater retention and plant growth in a green roof.
Due to the lack of a good understanding about the hydraulic efficiency of each green roof's layer in rainwater management, a detailed analysis of the hydrological dynamics, connected with the green roof technical design is essential in order to obtain a full characterization of the hydrologic behavior of a green roof system and its effects on the urban water cycle components. The purpose of this research is analyzing the soil-water dynamics through the different components of a green roof and modeling these processes though a detailed but clear subsurface hydrology module, based on green roof vertical soil water movement reproduction, in relation to climate forcing, basic technology components and geometric characteristics of green roof systems (thickness of the stratigraphy, soil layers and materials, vegetation typology and density).
A multi-layer bucket model has been applied to examine the hydrological response of the green roof system under a temperate maritime climate, by varying the physical and geometric parameters that characterize the different components of the vegetated cover. Following a stage of validation and calibration, results confirm the suitability of the model to describe the hydrologic response of the green roof during the observed rainfall events: the discharge hydrograph profile, volume and timing, predicted by the model, matched experimental measurements rather good, as demonstrated by the limited Nash–Sutcliffe model efficiency coefficient obtained both for the total discharged volume and the peak flow. The relative percentage deviations, obtained for the total discharged volume and the peak flow at event scale, shows that the model slightly tends to overestimate the effluent volume and underestimates the peak flow rate.