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A high-resolution lysimeter study of water transport processes of paved surfaces

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Paved surfaces are key characteristics of urban space that drastically alter hydrological processes. They are often seen as impermeable runoff generator preventing infiltration and evaporation. Numerous studies indicate that this simplification is not accurate and, depending on the paving material, infiltration and evaporation can exceed the amount of generated runoff. However, most studies are done as a short-term experiment or focus solely on one process such as runoff after heavy rainfall events. The annual hydrological balance of paved surfaces has been measured in only a handful of studies. In Berlin, two paved weighable lysimeters were equipped with multiple temperature and soil moisture sensors in order to study their hydrological balance, as well as water and heat transport processes within the soil profile. The two studied paving materials, cobblestones with wide joints and large concrete slabs with narrow joints, range from a low to a high sealing degree. Combining these two methods and a high temporal resolution affirms previous observations and offers new insights into altered hydrological processes near the surface. After one year of measurements, the annual hydrological balances for these two paved surfaces confirm that evaporation and infiltration can exceed runoff. Results show the importance of using rainfall intensities: high rainfall events generate runoff while low intensities lead to an increased evaporation and infiltration. It could be shown that the paved layer does not necessarily act as an evaporation barrier. An upward water transport from the underlying soil layers can lead to an increased evaporation. These findings prove that paved surfaces are more than a runoff generator. Therefore, they should not be treated as such when modelling the annual water balance of paved surfaces. Additionally, we are much more able to design urban areas according to desired ecosystem function (infiltrating, cooling).