Urban groundwater budget under evaporation-optimized pervious concrete pavements

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Pavement systems of pervious concrete blocks have a certain water retention and storage capacity for rainwater and therefore in addition to higher groundwater recharge rates a higher evapotranspiration rate compared to a pavement system of impervious concrete blocks. Over the test period from August 2008 to November 2011 a total of 336 actual daily evapotranspiration rates were measured in a test field situated in Coesfeld, Germany, under a moderate oceanic and semi-humid climate with an average annual precipitation rate (AAPR) of 843 mm a using the tunnel-evaporation gauge. The newly developed evaporation-optimized pervious concrete pavement system as well as two groove-and-stone-systems with various seam parts has a 2.4 times higher evapotranspiration rate of 149 mm a (18 % of AAPR) compared to an impervious pavement system with 62 mm a (7 % of AAPR). A pervious concrete grass grid has a nearly nine fold higher evapotranspiration of 545 mm a (65 % of AAPR). Based on these measurements the impacts of large scale usage on urban evapotranspiration rates were estimated in Münster (Germany), a city with 300,000 inhabitants 30 km eastward of Coesfeld. In the used program GwNeu. observed data are combined to provide the annual area-weighted average evapotranspiration allowing for sealed surfaces. The estimation outcomes show significant impacts on evapotranspiration+ for example, even if only the existing interlocking concrete pavements were replaced, then 630,000 m3 a additional water would be evaporated. Also, if a further 15 % of the existing sealed surfaces were replaced, 950,000 m3 a more water would be evaporated. This would lead to an increased energy transfer (1.5·1015 - 2.3·1015 J a) to the atmosphere. The extensive future use of pervious pavements can attenuate the urban water balance to the natural state.