

Modelling of the urban water cycle and the consequences of massive rain runoff infiltration for Copenhagen

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Abstract An integrated model is used to simulate the water cycle of the Copenhagen area (Denmark, 976 km²) during the period 1850–2003. The water cycle is quantified in terms of root zone water balance, water supply, wastewater, rain runoff, groundwater flow, and streamflow. The simulation indicates that the historical increase in precipitation (20%) has led to a 36% net increase in recharge, although urbanization has prevented groundwater recharge due to impermeabilisation and negligible contributions from leaky pipe systems. A model scenario that attempts to infiltrate all rain runoff from the city shows that only 25% of present rain runoff can be infiltrated due to a shallow groundwater table. In the area, 51% of the rain runoff infiltration is simulated to find other pathways to the sewer pipes as groundwater infiltration. The baseflow of the depleted streams in the region will only increase by 18% if rain runoff is infiltrated.

Key words urban; water cycle; groundwater; rain runoff; wastewater; streamflow; modelling