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Dynamics in urban water quality: monitoring the Amsterdam city area

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Urban water quality is influenced by a large number of heterogeneous sources. We aimed to identify solute pathways from different sources in the urban area of Amsterdam, The Netherlands. The city is situated in the Dutch delta, and largely below mean sea level. The water system of the centre of the city is connected to the large fresh water lake Ijsselmeer, but suburbs are mainly located within reclaimed lake and polder areas where water is pumped out in order to maintain the water levels, which are generally 1 tot 4 m. below sea level. Sources of water include: urban storm runoff, inlet water from the Ijsselmeer and surrounding areas, groundwater seepage and possibly also leaking sewage systems. The temporal dynamics and spatial patterns related to these flow routes and sources were largely unknown to date. Water quality is measured at those pumping stations systematically each month. We analysed the pumping discharge data and the concentration data to calculate daily water balances and annual load estimates for HCO_3,Ca, Cl, Na, SO4, Ptot, Ntot ,NH4, NH3 and NO_3. Chloride appears to be a good tracer to identify inlet water and bicarbonate and DIC were effective to estimate the groundwater contribution to the surface water outflow to the regional system. We were able to improve the solute balances by calibrating the measured temporal patterns of chloride and DIC using known concentrations from the individual sources. Subsequently the water balances where used to identify periods where one of the sources was dominant and by doing so we improved our understanding of the dynamics of N, P and S fluxes and the relations with dry and wet meteorological conditions. It appeared that N and P were largely related to groundwater outflow , whereas S was mainly related to dry periods and shallow flow routes influenced by sewage, urban storm runoff and shallow groundwater flow . The results are used to optimize urban water management which benefits from the improved insight in dominant processes and solute pathways.