Monitoring of trace metals and pharmaceuticals as anthropogenic and socio-economic indicators of urban and industrial impact on surface waters

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The research focuses on the monitoring of trace metals and pharmaceuticals as potential anthropogenic indicators of industrial and urban influences on surface water in poorly gauged transboundary Ukraine/Russia region. This study includes analysis of tracers use for the indication of water pollution events, including controlled and emerging discharges, and discussion of the detection method of these chemicals. The following criteria were proposed for the evaluation of indicators: specificity (physical chemical properties), variability (spatial and temporal) and practicality (capacity of the sampling and analytical techniques). The combination of grab and passive water sampling (i.e. DGT and POCIS) procedure was applied for the determination of dissolved and labile trace metals (Ag, Cd, Cr, Cu, Ni, Pb and Zn) and pharmaceuticals (carbamazepine, diazepam, paracetamol, caffeine, diclofenac and ketoprofen). Samples were analysed using ICP – MS (trace metals) and LC-MS/MS ESI +/- (pharmaceuticals). Our results demonstrate the distinctive spatial and temporal patterns of trace elements distribution along an urban watercourse. Accordingly, two general groups of trace metals have been discriminated: 'stable' (Cd and Cr) and 'time-varying' (Cu, Zn, Ni and Pb). The relationship Cd » Cu > Ag > Cr $\geq$ Zn was proposed as an anthropogenic signature of the industrial and urban activities pressuring the environment from point sources (municipal wastewaters) and the group Pb - Ni was discussed as a relevant fingerprint of the economic activity (industry and transport) mainly from non-point sources (run-off, atmospheric depositions, etc.). Pharmaceuticals with contrasting hydro-chemical properties of molecules (water solubility, bioaccumulation, persistence during wastewater treatment processes) were discriminated on conservative, labile and with combined properties in order to provide information on wastewater treatment plant efficiency, punctual events (e.g. accidents on sewage works, run-off) and uncontrolled discharges. Applying mass balance modeling, medicaments were described as relevant socio-economic indicators, which can give a picture of main social aspects of the region.