Distribution of persistent organic pollutants and trace metals in surface waters in the Seversky Donets River basin (Eastern Ukraine)

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The paper is focused on surface water of the Seversky Donets River Basin in Eastern Ukraine which undergoes significant anthropogenic pressure due to municipal and industrial wastewater discharge, polluted runoff from both urban and agricultural areas, leakages at oil-gas extraction sites located in the region. In these conditions the Seversky Donets River is used for drinking water supply of the city of Kharkiv with 1.5 million inhabitants as well as other smaller settlements in the basin. The diversity of water pollution sources makes it reasonable to use complex indicators and assessment approaches such as combination of organic and inorganic pollutants. We have studied the distribution of major ions, metals and persistent organic compounds (PAHs and PCBs) in water of the Seversky Donets River and its tributaries. In total 20 sites have been sampled on the river catchment area as of 4.5 thousands km2. PAHs and PCBs were measured in surface water for the first time in the region.

The most distinctive transformations of water composition have been found downstream wastewater treatment plants in the city of Kharkiv where treated mixture of municipal and industrial wastewater is discharged to the river. Such metals as Ni, Zn, Cr in combination with phosphates and nitrates has shown significant positive correlation indicating the common source of their input.

Ten of sixteen total PAHs were detected in measurable concentrations in at least one sample of river water. Sum of PAHs ranged from 15.3 to 117.2 ng/L with mean of 43.8 ng/L. The ratios of PAHs have indicated rather pyrogenic than petrogenic inputs on all the studied sites. Elevated concentrations of low molecular weight PAHs in water were found close to a coal-burning power station and a coke chemical plant also confirming their origin from coal combustion and subsequent atmospheric deposition.

PCBs distribution has appeared to be relatively uniform on the territory despite the vast area of the basin researched. Only four from eleven PCB congeners analyzed in water have been found in detectable concentrations. The total sum of four PCBs (52, 77, 126, 169) has been measured as of 200–235 ng/L with very low spatial variations presenting a kind of background values. Such distribution suggests probably atmospheric deposition of PCBs but sources of these pollutants still remain unidentified and need to be investigated further.