Long term impact of PAH contamination in soils on the water quality in rivers

David Gateuille, Olivier Evrard, Elodie Moreau-Guigon, Marc Chevreuil, Jean-Marie Mouchel

Geophysical Research Abstracts
Vol. 16, EGU2014-4051, 2014
EGU General Assembly 2014

Long term impact of PAH contamination in soils on the water quality in rivers

David Gateuille (1), Olivier Evrard (2), Elodie Moreau-Guigon (1), Marc Chevreuil (1), and Jean-Marie Mouchel (1)

(1) UPMC, Paris, France (david.gateuille@upmc.fr), (2) CEA, Gif/Yvette, France

Polycyclic Aromatic Hydrocarbons constitute a large family of hazardous contaminants that are mainly released into the environment by incomplete combustion of organic matter. In the Seine River (France), high concentrations of these compounds measured in the water bodies might prevent to meet the international environmental targets requested by EU Water Framework Directive. This issue is of particular concern as PAH emissions have been steadily decreasing for several decades. Consequently, both the origin and the persistence of these pollutants have to be investigated. PAHs are known to bind onto organic matter in soils and large amount of these compounds may be found in this compartment. In order to investigate the role of soils as a contamination buffer, an ambitious sampling strategy was implemented in an upstream agricultural subcatchment (104 km^2) for an entire hydrological year. The samples were collected in the different compartments (atmospheric fallout (n = 42), soil (n = 33), river water (n = 26) and suspended sediment (n=101)) and allowed to quantify the current fluxes of PAHs in the environment and to estimate their stocks in soils (12 to 220 $kg.km^{-2}$). Annual mass balance calculation was conducted at the catchment scale and showed that current PAH losses were mainly due to losses (biodegradation, photo-oxidation and volatilization) within the catchments (about 80%), whereas exports due to soil erosion and riverine transport appeared to be of minor importance. When comparing the stocks in soils and the estimated annual losses, PAHs showed long decontamination times in soils (40 to 1850 years). The fate of PAHs in the catchment varied from one compound to another and was controlled by meteorological and hydrological parameters. This result highlights that soils are likely to play an important role as a secondary source for riverine contamination for a long period of time. To investigate further the relationship between the presence of PAHs in soils and the contamination of water bodies, the influence of soil erosion and particle transfer on their physico-chemical properties was investigated. Indeed, a sharp increase of PAH concentration in particles was observed between soils and suspended sediment in the investigated subcatchments. A rise in organic carbon content and a decrease in the mean size of particles were observed between soils and suspended sediment. Those results show that particle sorting occurs during erosion and transportation processes and these changes explain the strong impact of soil contamination on water quality in rivers.