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3D Fluorescence spectroscopy to estimate quality and quantity of dissolved organic matter in the Seine River: assessment of the weekly monitoring carried out from the upstream to the downstream of the Paris agglomeration during a hydrological year

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Dissolved organic matter (DOM) is ubiquitous in surface water and influence water quality. DOM is well known to influence bioavailability and speciation of metallic and organic micro-pollutants into receiving waters. DOM also represents a challenge for drinking water management as its treatability is subject to inter-seasonal variations (high/low flow-winter/summer) and could induce formation of carcinogenic disinfection by products (DBP). Current methods used to characterize organic matter quality are laborious, time consuming, and sometimes not applicable to directly monitor organic matter in situ. This stresses the need of a new methodology which helps anticipate variations of DOM quality and quantity in freshwater. The present work has been carried out in the context of MOCOPEE research program (www.mocopee.com) and Piren-Seine research program (http://www.metis.upmc.fr/piren/). It aims to assess the use of optical techniques, such as UV-Visible absorbance and more specifically fluorescence spectroscopy in order to monitor and characterize DOM in the Seine River watershed, which is currently subject to an important urban pressure.

Since July 2015, global parameters, UV-Vis absorbance and 3D fluorescence spectroscopy coupled with PARAFAC analysis have been investigated inside a weekly monitoring of DOM at several locations in the Seine River watershed (n=373 samples). This measurement network carried out by SIAAP (Paris Inter-Departmental Sanitation consortium) called “MeSeine” integrates 13 sampling points from upstream to the downstream of Paris and in its two main affluents (Marne and Oise rivers). Results from the first year of monitoring will be presented. From these results, we developed different multivariate linear regression models so as to predict a variety of water quality parameters by fluorescence intensity at specific excitation-emission wavelengths.

A 10 component PARAFAC model allowed us to observe change in DOM quality between the different rivers investigated. We also highlighted a wastewater effluent impact into the Seine River resulting from maintenance operations in the largest Parisian wastewater treatment plant (1,700,000 m3/day), with an increase in protein-like fluorescence intensity. Variations of fluorescence intensity between high and low flows was measured with a predominance of Humic-like compounds during a 10-year occurrence flood event. Spatio-temporal variations of DOM fluorescence quality and quantity was emphasized. Correlations were found between fluorescence indicators and different water quality key parameters in the natural water. For example, dissolved organic carbon concentration ($r^2=0.800$; $p<0.0001$; $n=373$) presents good correlation with specific fluorescence peaks and indicators.