Geophysical Research Abstracts
Vol. 21, EGU2019-11680, 2019
EGU General Assembly 2019

Toward a better knowledge of domestic sewage fluorescent dissolved organic matter: a study of its biological and physicochemical properties

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Dissolved organic matter (DOM) fluorescence from domestic sewage is most often dominated by the presence of protein-like components with a lowest part of humic substances-like components (Goffin et al., 2018). Particular attention was paid on domestic sewage humic substances-like fluorescent components, which are poorly known, especially since synthetic organic molecules (e.g. optical brightening agents, OBAs) are likely to fluoresce in the same excitation-emission wavelength areas of the fluorescence spectrum. This study (MOCOPEE research program) aims to use physicochemical and biological fractionation methods coupled with excitation-emission matrix (EEM) fluorescence spectroscopy to better understand the origin of humic substances-like fluorescence signature observed in domestic sewage.

Different nature of filtrated samples (0.45 μm; GF/F filters) were investigated: domestic sewage samples form the “Seine Centre” wastewater treatment plant (240,000 m^3/day; Colombes, France); samples from French Rivers under low urban pressure; Suwannee River fulvic acid standard (IHSS) and laundry detergent solutions with or without OBAs. All samples were fractionated on DAX-8/XAD-4/AGMP-50/AGMP-1 resins in duplicates following protocol used by Matar (2012). Dissolved organic carbon (DOC) measurements were made for each resin effluents and analysed at pH 8 with EEM fluorescence spectroscopy. Biodegradability experiments were also made on the previous filtered samples (0.45 μm; GF/F filters) using an Oxitop® respirometer under dark condition for 15 days. EEM fluorescence spectroscopy and DOC measurements were made at 0 and 15 days of experimentations, in triplicates.

Humic substances are known to be retained on DAX-8 resin (Peuravuori et al., 2002) and to be relatively refractory to biodegradation compared to protein. Domestic sewage biodegradation experiments highlighted a high biodegradability of protein-like fluorescent components (-90% of fluorescence intensity) and an increase of humic substances-like fluorescent components (+28% of fluorescence intensity) observed between 0 and 15 incubation days. Fractionation by DAX-8 resins showed only half of the domestic sewage humic substances-like fluorescence (55%) was observed in the hydrophobic acid fraction. All these observations raised doubts about the attribution of humic substances-like fluorescence signal to real humic substances in domestic sewage. According to a mass balance calculation it can be possible that OBAs are emitted in sufficient quantities to cause about 10% of the fluorescence observed for humic substances-like components in domestic sewage.

Results obtained provide a better understanding of domestic sewage fluorescent DOM biological and physicochemical properties. This will help to better understand their future evolution during the wastewater treatment plant process.

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