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Fingerprinting approach to trace sedimentary and contaminant sources in a canalized section of the Scheldt river (Northern France) for watershed management

Dylan Laurence[1,2], Christine Franke[1], Claire Alary[2,3], Marion Delplanque[4], and Laurent De Windt[1]

[1]MINES ParisTech, PSL University, Centre of Geosciences, 35 rue Saint-Honoré, 77305 Fontainebleau Cedex, France
[2]IMT Nord Europe, Institut Mines-Télécom, Centre for Materials and Processes, F-59000 Lille, France
[3]Univ. Lille, Institut Mines-Télécom, Univ. Artois, Junia, ULR 4515 - LGCgE – Laboratoire de Génie Civil et géoEnvironnement, F-59000 Lille, France
[4]Voies navigables de France, Territorial Direction of the Nord-Pas-de-Calais, 37 Rue du Plat, 59034 Lille, France

Watershed management is an important issue throughout Europe. A key point is that business activities that prosper through fluvial transport require optimal conditions of navigation, leading to a double problematic. On one hand, urbanization, industrial, and agricultural activities have evolved to intensifying inflow to water ways (run off and effluents). Input of particulate matter to river networks has hampered functionality of water gates and fluvial circulation. On the other hand, due to human activities (industry, wastewater treatment plants, domestic and agricultural drains), particulate matter may become a contamination vector in the fluvial realm and thus may degrade sediment and water quality.

The territorial direction of the Voies Navigables de France (VNF) of the Nord-Pas-de-Calais is responsible of the maintenance of all water ways in the Northern France region. Regular dredging campaigns are necessary to maintain optimal navigation conditions, which produces ~100.000 m^3 of sediment waste each year. VNF has the ambition to both prevent particle and contaminant inputs into the water ways and valorize the dredged sediments. However, this is not feasible without a detailed knowledge of the contribution of particulate matter sources, which requires a source-to-sink approach for both sediments and contaminants.

The present study aims to spatialize and quantify the contribution of particulate matter sources and their role on the sediment contamination using a sediment fingerprint approach (e.g. Haddadchi et al., 2013). The focus is on the canalized Denain-Trith reach of the Scheldt River which presents an important sediment accrual (about 18.000 m^3/year) contaminated by heavy metals (Zn, Pb, Cd) and organic compounds.

Geochemical and mineralogical analyses were performed on about 200 riverbed sediments and 30 topsoil samples by powder X-ray diffraction, X-ray fluorescence, ICP-MS, and chemo-analytical methods adapted to organic compounds (RRLC-MS/MS, HPLC-MS). This set of analyses is used as

tracers of the different particulate sources. Effluent samples are also analyzed to evaluate the contribution of anthropogenic inputs. Preliminary results have already demonstrated the spatial distribution of metal contamination in the reach, which can be related to spot sources, and led to a first estimation of their respective contributions. Geostatistical analyses (such as kriging) will be further used to assess the impact of contaminant sediment accrual on the sediment source quantification (Alary and Demougeot-Renard, 2010).

Alary, C., Demougeot-Renard, H., 2010. Factorial Kriging Analysis As a Tool for Explaining the Complex Spatial Distribution of Metals in Sediments. Environ. Sci. Technol. 44, 593–599. https://doi.org/10.1021/es9022305

Haddadchi, A., Ryder, D.S., Evrard, O., Olley, J., 2013. Sediment fingerprinting in fluvial systems: review of tracers, sediment sources and mixing models. International Journal of Sediment Research 28, 560–578. https://doi.org/10.1016/S1001-6279(14)60013-5