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Particulate flux calculation based on metal contents and suspended sediment concentrations relationship: case study of turbid alpine river (Isere, France)

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In the context of increasing stress on aquatic environment, the improvement of pollutant flux quantification in large rivers presents a strong stake. Isere at Grenoble city (5570 km2) is an alpine river in the Northern French Alps with high suspended sediment transport reaching 10 to 20 g L-1 during floods. It is known that for elements like P, Ni, Mn, Cr, Pb, Fe et Al, most of river transport is done under particulate forms. Isere River is susceptible to transport particulate pollutants such as metals, given mining history and industrial activities at the upstream watershed. Moreover, this river receives Grenoble city's effluents (500 000 inhabitants) and stormwaters during rain events. Three metals (Hg, Ni, Pb) identified as priority substances regarding European Water Framework Directive and As known to be one of the most metal of concern were chosen in this study.

High frequency samplings of suspended sediments were realized between 2011 and 2012 in order to evaluate the temporal variation of metals contents and to determine geochemical background during high flow periods. In the same sampling site (situated upstream urban effluents of Grenoble city), discharge and suspended sediment concentration by turbidity were measured at 30 min frequency by a monitoring station.

The use of historical and new databases ranging between low and high discharge (10 years return flood) allowed determining relationships between metal contents and suspended sediment concentrations and discharges. Results show a good correlation for the studied metals and permit to defined the geochemical backgrounds for each metals measured above 0.5 g L-1, (Hg = 68 +/- 48 ng g-1, Ni = 30 +/- 10 mg g-1, Pb = 43 +/-13 mg g-1, As = 15 +/- 4 mg g-1). These models were validated on a separated period than the one used for the calibration and applied to calculate particulate metals concentrations and associated incertitude at 30 min frequency using SSC and discharge database. Cumulative 30 minutes fluxes allowed to calculate annual or flood events fluxes and to compare them with classical flux estimation in rivers.

This method of flux calculation presents a great interest to better understand temporal particulate metals dynamics within rivers and for metals balance estimation at regional scale including urban areas.