



## **Assessing nitrification and denitrification in the Seine river and estuary using chemical and isotopic techniques**

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Downstream from metropolitan Paris (France), a large amount of ammonium is discharged into the Seine River by the effluents of the wastewater treatment plant at Achères. To assess the extent of nitrification and denitrification in the water column, concentrations and isotopic compositions of ammonium ( $\delta^{15}\text{N-NH}_4^+$ ) and nitrate ( $\delta^{15}\text{N-NO}_3^-$ ,  $\delta^{18}\text{O-NO}_3^-$ ) were measured during summer low flow conditions along the lower Seine and its estuary. The results indicated that most of the ammonium released from the wastewater treatment plant is nitrified in the lower Seine River and its upper estuary, but there was no evidence for water-column denitrification.

In the lower part of the estuary, however, concentration and isotopic data for nitrate were not consistent with simple mixing between riverine and marine nitrate. A significant departure of the nitrate isotopic composition from what would be expected from simple mixing of freshwater and marine nitrates suggested coupled nitrification and denitrification in the water, in spite of the apparent conservative behaviour of nitrate. A model was developed to calculate rate of denitrification. Results estimated a rate of approximately  $1.5 \mu\text{mol/L/h}$  for this part of the estuary.

The model was used for the Loire Estuary. Rates of denitrification were approximately  $0.5 \mu\text{mol/L/h}$ .