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## Organotin speciation and distribution along the fluvial-estuarine continuum of the Gironde Estuary (France)

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### Abstract

The massive use of tributyltin (TBT) within antifouling paints in the 70s and its toxicity to marine wildlife (imposex, mortality), has triggered its stepwise ban from all paints since 1982 (European Directive 03/782/CE). Despite this, TBT and its degradation products (dibutyltin, DBT; monobutyltin, MBT) persist in the environment and ongoing organotin inputs by urban wastewater due to other industrial applications contribute to their presence in aquatic systems at levels which are not conform with environmental quality regulation. We present a one-year follow-up (monthly samplings) of dissolved ( $\text{TBT}_d$ ,  $\text{DBT}_d$ ,  $\text{MBT}_d$ ) and particulate ( $\text{TBT}_p$ ,  $\text{DBT}_p$ ,  $\text{MBT}_p$ ) organotins for two sampling sites the Central Water Masses (CWM) of the Gironde Estuary defined by the Water Framework Directive. Organotin distribution along the estuary under contrasting hydrological situations provides insights into estuarine cycle and potential sources. The annual TBT concentration average in the CWM ( $0.44 \text{ ng l}^{-1}$ ) is higher than the Environmental Quality Standard ( $\text{EQS} = 0.2 \text{ ng l}^{-1}$ ), downgrading the CWM to “poor chemical status” for 2015. In urban wastewater from the Bordeaux agglomeration and in the nearby fluvial estuary, dissolved  $\text{TBT}_d$  and  $\text{MBT}_d$  are dominant (up to  $1 \text{ ng l}^{-1}$ ), with low or not detectable DBT levels, whereas the complete degradation chain (TBT-DBT-MBT) occurs in the marine part of the estuary, probably linked to harbor activities. Organotin concentrations and degradation patterns ( $\text{TBT}_p/\text{DBT}_p/\text{MBT}_p$ ) in sediments are similar for different harbours of the marine Gironde Estuary and correspond to typical values in suspended particles. In the estuarine water column, dissolved species generally represent the majority of total (dissolved + particulate) organotin. However, their overall level ( $\text{TBT}_d$  up to  $0.5 \text{ ng l}^{-1}$ ;  $\text{DBT}_d$  and  $\text{MBT}_d$  varying from 2 to  $8 \text{ ng l}^{-1}$ ) and relative composition ( $\text{TBT}_d/\text{DBT}_d/\text{MBT}_d$ ) are highly variable, suggesting hydrological control and major organotin sources in the downstream reaches.

**Keywords:** Organotins, Gironde Estuary, water mass quality, anthropogenic sources