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Preliminary Gaussian process regression to identify the impact of anthropogenic releases in aquatic systems: case study of Sb in the Garonne River

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Antimony (Sb) is a toxic, ubiquitous oxyanion and a priority contaminant in Europe (EU Directive 2006/11/EC). Its radioactive homologue (i.e., ^{125}Sb; $t_{1/2}$ = 2.76 y), is discharged to the ocean from fuel reprocessing plants (e.g., La Hague) and was emitted to the environment after the Chernobyl (ChNPP, Ukraine 26th April 1986) and Fukushima Dai-ichi (FDNPP, Japan 11th March 2011) nuclear power plant accidents. However, little understanding of the reactivity, transport and fate of Sb is known for aquatic systems. Therefore, evaluating the impact of Sb anthropogenic releases (either stable or radioactive) into specific environments such as continent-ocean transition systems is still a challenge. For a deeper understanding, spatial and temporal variability of the solid-liquid partitioning, as well as the key processes involved in such Sb distribution, should be accounted for in the regional area of interest. In addition, the representative dataset can be combined with a machine learning approach to provide reliable and robust predictive methods for further evaluating unknown conditions. In this work, we focus on understanding the key processes involved in the reactivity of Sb from a 14-year long-term data series of dissolved and particulate Sb concentrations in the Garonne River (SW France)[1]. Gaussian process regression is employed to identify reliable kernels (i.e., trend, seasonality and events) representing physical patterns (i.e., river discharge, suspended sediment load) that influence the specific Sb behaviour. This state-of-the-art approach characterizes the inherent trend and seasonal dynamics of the Garonne River, allowing to model the resilience of the system towards anthropogenic discharges. This study serves as a first step for providing insights on the expected behaviour of anthropogenic releases in aquatic systems, applicable to other elements/systems and useful for watershed management of potentially contaminated sites.

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References: [1] Gil-Díaz, T., Schäfer, J., Coynel, A., Bossy, C., Dutruch, L., Blanc, G. (2018). Antimony in the Lot–Garonne River system: a 14-year record of solid–liquid partitioning and fluxes. Environmental Chemistry, 15(3), 121-136.