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Reduction of pharmaceutical loads in rivers: an integrated model that facilitates decision-making processes

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Abstract: River Basin Authorities require models and decision support tools to predict loads of Pharmaceutical Active Compounds (PhACs) in surface water and facilitate the evaluation of reduction strategies through urban wastewater system upgrades. We propose a water management support tool which describes the fate and removal of PhACs along the entire catchment and can be used to simulate investments to minimize PhACs loads in the environment. The tool integrates a substance-human consumption and excretion model, a wastewater treatment plant (WWTP) model, and a river model. Uncertainty associated to three model parameters (PhAC human consumption and excretion, PhAC degradation constant in WWTPs and PhAC degradation constant in rivers) can be propagated through the model. The usefulness of the model-based approach was validated with data from the Llobregat river basin (Spain, NE), with 4.948 km2 catchment area, and with 56 WWTPs discharging to the river. D*iclofenac* was the PhAC target compound. The model was built and calibrated using Bayesian inference and Markov Chain Monte Carlo simulations. The results show that the model can predict very well (r^2=0.95) measured *diclofenac* loads at 14 river locations for one set of measurements collected in September 2010. Based on the calibrated model it was possible to estimate that 25 kg/year of *diclofenac* were attenuated in the WWTPs, while 17 Kg/year were attenuated in the river. The results highlight the important role that rivers play in the attenuation of *diclofenac* throughout the urban wastewater cycle. The model is flexible and adaptable and can easily be ported to different contexts, and is being used to evaluate WWTP upgrades.

Keywords*:* Microcontaminants; Decision support tool; Water management; Bayesian