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Investigation of the major uncertainty sources of an integrated plant-wide wastewater treatment model

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A plant-wide mathematical model has been developed in order to simulate the operation of urban wastewater treatment plants. he model consists of several sub-models, one for each treatment unit. The model is able to assess the effluent quality, the energy and chemicals consumption and the greenhouse gas emissions (GHG). The biological process model is based on a modification of the activated sludge model no.1 (ASM1) including all the biological processes related to N2O and CO_2 production pathways. To simulate settling processes, a one-dimensional model was used which is based on the general flux theory for zone settling, while an anaerobic digestion sub-model based on a modification of activated digestion model no.1 (ADM1) was developed. Finally simulation of the other treatment units (pretreatment, primary treatment, gravity and mechanical thickening and dewatering) is based on mass balances based on the efficiency of each unit. It is well known that there is a high level of uncertainty when determining the appropriate values of the stoichiometric and kinetic parameters employed in the model's kinetic equations. Most of these values are derived through experimental procedures conducted under different conditions thus presenting high variability. A Monte Carlo based approach was used to provide for the identification of the most important model's stoichiometric and kinetic parameters that affects model's results. The mathematical model takes into account the random fluctuation of these parameters by creating a range of possible values for each one of them and a corresponding probability distribution. Thus values selection is taking place in a pseudo-random way through a specific probability distribution (normal, lognormal, uniform, etc.). Based on the results prioritization of uncertainty sources was implemented.