Geophysical Research Abstracts
Vol. 20, EGU2018-18135, 2018
EGU General Assembly 2018

Advances in Grey Water Footprint Assessment: Indicator of the efficiency in a Waste Water Treatment Plant

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The Grey Water Footprint (GWF) is a pollution indicator that quantifies the minimum volume of freshwater required to assimilate pollutant loads based on existing ambient water quality standards. To integrate in the urban water cycle, we propose its adaptation to the specific domain of a waste water treatment plant (WWTP). Based on the Water Footprint Assessment (WFA), the framework proposed for assessing the WWTP management provides specific measures to indicate different aspects of management of a WWTP. This is, the GWF assessment in a WWTP depends on the mass balance is performed for each pollutant, in which there are no chemical reactions involved, that is, according to a perfect mixing process.

From the different possible mass balances for the definition of indicator, we have evaluated the total grey water footprint ($W_{G,T}$) which defines the not-treatment scenario, and the grey water footprint reduction ($W_{G,ref}$) to examine the input and output values of the WWTP in the current treatment scenario. Consequently, $\Delta W_{G,T-ref}$ was established as the residual grey water footprint, i.e., the grey water footprint is obtained once the treatment is completed. Finally, the new indicator proposed is the operational grey water footprint ($\Delta W_{G,mef}$) to show company managers and water management stakeholders how to carry out regulatory requirements.The target of $\Delta W_{G,mef}$ indicator is to better assess the role of WWTPs in reducing human impacts on water resources and to estimate of suitability of the operation of the WWTP with the legal standards. Therefore, the development of the GWF defined by WFA in a WWTP would highlight the beneficial role of WWTPs within the environment and provide a complementary information to evaluate the impact of a WWTP regarding to the use of freshwater and energy.

This methodology was applied in four different WWTP located in Extremadura (SW Spain) characterized by activated sludge process as secondary treatment. The WF estimation and its relationship with the electricity consumption examines the efficiency of each WWTP, diagnose management weaknesses in terms of the sustainability and what are the suggestions to improve the management from an environmental perspective. The approach proposed supposes a novelty in the development of WFA and establishes a new framework for multidisciplinary decision-making that combines water use, consumption and environmental impacts.