EGU21-1672
https://doi.org/10.5194/egusphere-egu21-1672
EGU General Assembly 2021

Development of scenarios for future emissions of chemicals from agricultural, industrial and urban systems

Poornima Nagesh[1], Hugo J. de boer[1], Stefan C. Dekker[1], and Detlef P. van Vuuren[1,2]
[1]Utrecht University, Department of Environmental Sciences, Copernicus Institute of Sustainable Development, Utrecht, Netherlands (p.nagesh@uu.nl)
[2]PBL Netherlands Environmental Assessment Agency, The Hague, Netherlands

Water is an essential resource for human life and the environment. The widespread use of chemicals in daily life has led to significant water quality concerns. During the production phase, the use phase as well as after use, (residues of) these chemicals can enter the environment and water systems. Furthermore, the use and production of chemicals are increasing rapidly, driven by mainly population growth, urbanisation and economic growth. Increased use leads to further emissions of chemicals to water, posing significant water quality concerns. Henceforth there is an urgent need to understand the linkage between society and production and consumption of chemicals to explore possible changes in water quality.

Socio-economic scenario analysis is a useful tool to investigate the long-term consequences of future change and mitigation options. While scenarios have been broadly applied to understand air pollution, this not yet the case for chemical pollution to surface waters. In this work, we propose a general framework to develop scenarios for the future emissions of chemicals to water by using the Shared Socio-economic Pathways (SSP). The framework follows the basic elements of the scenario development process by defining the current system, describe the changes in emissions with scenario drivers and elaboration to the future. The framework is then tested on a set of selected 'example' chemicals that represent broader chemical groups of pharmaceuticals (Ibuprofen and Diclofenac), pesticides (Terbuthylazine) and industrial chemicals (Cadmium and Di-ethyl phthalate). Chemical emissions to water over the past years were used to understand their yearly trends and patterns over the European countries. Lastly, the emission scenarios for chemicals for 2050 were developed by using SSP drivers from the IMAGE Integrated assessment model as an input to the empirical emission models. The three SSP scenarios: SSP1 ("Sustainability"), SSP2 ("Middle of the Road") and SSP3 ("Regional Rivalry") focusing on Europe were included. Additionally, the developed scenarios also describe mitigation efforts.

The results of emission scenarios displayed an increase in emissions up to 2050 for the exemplary chemicals in Western Europe for all three scenarios SSP1, SSP2 and SSP3. While the emissions of chemicals linearly decreased in Eastern Europe for the same period. SSP3 showed the highest emissions in 2050 except for cadmium emissions from wastewater treatment plants. The results showed that the framework helps in understanding the possible influence of socio-economic

changes on use and emissions of chemicals which can be a part of future risk assessments. While the framework can be extended similarly to other pharmaceuticals and pesticides, it requires a detailed understanding of complex emission sources for industrial chemicals.