

The removal of pharmaceutical compounds in advanced wastewater treatments.

Level: MSc Thesis or Internship

Department: Environmental Science

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Duration: 6 months

Starting day: As soon as possible

Short description: in the framework of the European research project PREMIER (Prioritisation and Risk Evaluation of Medicines in the EnviRonment, www.imi-premier.eu), we are seeking an MSc student who will support us to implement models of advanced (i.e. tertiary) treatments targeting pharmaceutical compounds in wastewater treatment plants into an existing freshwater quality model.

Background

Pharmaceuticals have indisputably improved human health and life expectancy. However, following human use and excretion, active pharmaceutical ingredients (APIs) can reach the environment, posing a potential risk to humans and biota. The preferential pathway of APIs into the environment is through sewage collection and subsequent treatment in waste water treatment plants (WWTPs) resulting in effluents that are being discharged into freshwater systems. Since WWTPs only partially remove APIs, they are regularly detected in surface waters.

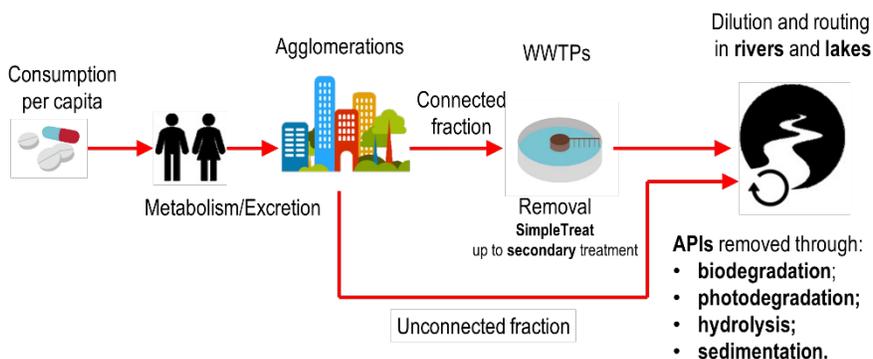


Figure 1. the ePiE model flowchart including the modelled processes.

In the Department of Environmental Science, we developed ePiE, a spatially distributed computational model able to predict the concentration of APIs in surface freshwaters of the European Continent (Austin et al., 2022; Oldenkamp et al., 2018). ePiE starts from medicines consumption and models the fate of the contaminants through the sewage system, WWTPs and surface waters as described in the flowchart in Figure 1. The model prediction permits to identify hotspots of high APIs' concentration (Figure 2) and it is essential to evaluate the environmental and human exposure and risk of such compounds. European WWTPs operate mainly up to the secondary treatments which have a limited efficiency to remove APIs.

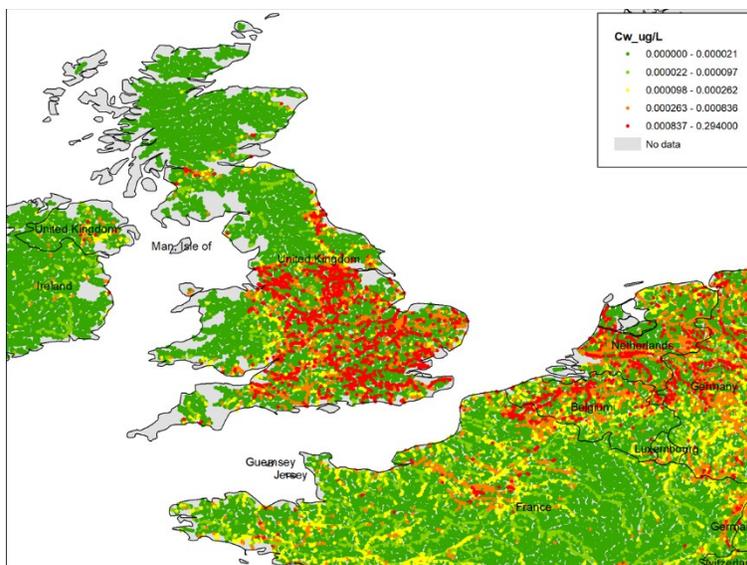


Figure 2. Example of ePiE model prediction of a specific active pharmaceutical ingredient concentration in rivers: zoom on a highly populated area of Europe.

Recently, advanced tertiary treatments targeting APIs are being implemented in European countries such as in Switzerland and Germany, and are being considered to be widely implemented within the European Union in the next future.

Currently, ePiE models WWTPs up to the secondary treatments. The student will have to explore and select existing models of tertiary treatments and support the department in implementing them into the ePiE model.

Objectives

- Gathering existing literature, data and existing models on WWTPs tertiary treatments of APIs;
- define models of tertiary treatments and implement them in the existing ePiE model;
- test and validation of the models in specific river basins.

The specific objectives will be discussed during the kick off meeting with student and supervisors, and elaborated in detail during the first month of the MSc project.

Methods

Literature review, model development, model application.

Requirements

Basic knowledge on environmental modeling and chemistry; interest in programming.

References

- Austin, T., Bregoli, F., Höhne, D., Hendriks, A. J., & Ragas, A. M. J. (2022). Ibuprofen exposure in Europe; ePiE as an alternative to costly environmental monitoring. *Environmental Research*, 209. <https://doi.org/https://doi.org/10.1016/j.envres.2022.112777>
- Oldenkamp, R., Hoeks, S., Čengić, M., Barbarossa, V., Burns, E. E., Boxall, A. B. A., & Ragas, A. M. J. (2018). A High-Resolution Spatial Model to Predict Exposure to Pharmaceuticals in European Surface Waters: ePiE. *Environmental Science & Technology*, 52(21), 12494–12503. <https://doi.org/10.1021/acs.est.8b03862>