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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "A parsimonious transport model of emerging contaminants at the river network scale" *by* Elena Diamantini and Alberto Bellin

Anonymous Referee #1

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General comments:

This manusript presents a simple approach to estimate concentrations of pharmaceuticals and personal care products (PPCP) in river networks through approximations of waste water treatment plant (WWTP) inflow and in-channel dilution. WWTP inflow is related to capita connected and thus an extrapolation to ungauged sites is theoretically possible, although the model requires local calibration to measured concentrations. While the general novelty of this approach is understood, the present manuscript lacks an adequate description of existing knowledge and a model check with data that was not used for calibration. Since independent data obviously exists – i.e. was published

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Discussion paper

in a preceding paper - such a model check is possible and would strongly contribute to the value of this research. Moreover, a large Lake of 180 mio m3 exists in the middle of the examined river network but is neither shown nor mentioned or adequately discussed. Such a lake will certainly affect model results and probably also violate underlying model assumptions. Only if all concerns are adequately addressed, publication in HESS is warranted. I detail these concerns down below.

Specific comments:

1. Existing knowledge: Concentrations of PPCPs

The paper lacks a description of existing studies on the occurrence and spatio-temporal dynamics of PPCPs in European rivers. In recent years several studies have been published in various river systems. This is important, because the results of the present studies should be compared to other regions to prove that both measured and simulated concentrations are realistic. I propose a table in the introduction where the five simulated compounds are selected and occurring concentrations are given for different rivers. Those should be used to evaluate model quality in the discussion. By the way: it is not true that PPCPs are not measured on a regular basis by environmental agencies: At least in the Rhine River measurement stations exist for this purpose (e.g. in Weil, check at: http://www.aue.bs.ch/umweltanalytik/rheinueberwachungsstation-weil-am-rhein.html

2. Existing knowledge: Model approaches

The literature overview at the end concentrates on two, relatively similar GIS-based model approaches, GREAT-ER and PhATE, that are both more than ten years old. More recent approaches are missing, e.g. the study of Osorio et al (2012) who applied a simple plug-flow model to simulate pharmacologically active compounds in the Ebro river taking into account different dilution by varying flow conditions and an overall decay constant. They also determined decay constants for ibuprofen, furosemide, enrofloxacin, enalapril, acetaminophen, diclofenac and ketoprofen. So the authors should state why they developed a new model and what are the differences and benefits of their approach. Finally they should also compare their calibrated decay constants to those by (Osorio et al. 2012).

3. Missing information about model boundary conditions

How was the weather (rainfall, air/water temperature, etc.) during the two sampling periods? Since water temperature and discharge are two main parameters that influence the model results, this information is crucial to evaluate the model results. If figure 3 of Mandaric et al. (2017) is considered, the runoff difference between the sampling campaigns of February and July is rather small for the two downstream sites WB4B and WB5B. Here absolute numbers should be presented in a table, in addition to weather conditions and air/water temperatures.

4. Missing information about Lake di Santa Giustina

A more accurate map of the study catchment is required. Unlike in the preceding paper, an existing large lake between upstream (WB3A and WB3B) and downstream (WB4B and WB5B) sites is not shown in the catchment map and even not mentioned in the paper. Why? This lake of 180 million m3 volume will largely increase residence times and mixing and certainly affect model results. This could also explain differing model results between the upstream and downstream stations. Moreover, such a large lake has impacts on various simplifying model assumptions, as discussed below. Here an extensive discussion is needed including a quantitative estimate on the solute residence times in the lake (at different discharge conditions).

5. Model assumptions

Limitations caused by the following model assumption need adequate discussion:

a.) the model only accounts for point sources. How large is the error by diffuse sources, e.g. sewer overflows during large rainfall events, manure use, etc. b.) the entire concept is based on the hypothesis that the scale of interest is larger than the residence time. Does this hold, especially regarding the big lake? c) can velocity be assumed to be spatially uniform within the channels (p 4)? Generally it seems more plausible that flow velocities are higher in steep headwaters and again, what about the lake? d) also the assumption that local dispersion is overwhelmed by geomorphological dispersion is problematic if one thinks about a large lake. e) how realistic is the assumption that every WWTP is equally efficient, i.e. has the same decay factor (p. 10)? From my experience there are large differences depending on the size of the WWTP, on its age and used techniques. Snip et al. (2014) exemplified the effect of different operation conditions on WWTP efficiency regarding PPCP removal. f) was the water temperature really constant throughout the network and throughout the three-day sampling campaign? Here again the balancing effect of the lake might play a role. Real measured data needs to be presented here (see 3. above).

6. Model check

Apart from the missing incorporation of the big lake, this is the main criticism of the presented approach: a missing model check with independent data. In the chapter 4 the model is extrapolated to the entire Adige river catchment and the spatial (Figure 5) and temporal (Figure 6) dynamics of selected components are shown. But how realistic are these results? Here the authors miss the chance of an independent model check. In their preceding paper Mandaric et al. (2017) presented additional data of the Adige catchment upstream the inflow of the Noce and downstream the town of Trento. This data could be used for a real model check and compared to simulated concentration WITHOUT re-calibrating the model.

7. Model description

A large part of the present manuscript consists of a presentation of the applied model approach, model selection and calibration strategy. The model description is lengthy and should be condensed. The section 2 “model” should be included into the section “material and methods”. Here the model development itself should be described in a first subsection followed by parameterization and calibration strategies. Most of the equations should be moved into the annex, and figure 1 be omitted.

8. Code and data availability

The sampled data should be provided as a table in the annex (upon publication the data is already published twice). Also the model code could be provided as an executable file.

Technical corrections:

The entire manuscript needs a thorough language check by a native speaker. Internet-Links should be omitted from the main text.

References:

Mandaric, L. et al. (2017): Contamination sources and distribution patterns of pharmaceuticals and personal care products in Alpine rivers strongly affected by tourism, Science of The Total Environment, 590, 484–494.

Osorio V. et al. (2012): Occurrence and modeling of pharmaceuticals on a sewage-impacted Mediterranean river and their dynamics under different hydrological conditions, Science of the Total Environment 440, 3–13.

Snip et al., (2014): Modelling the occurrence, transport and fate of pharmaceuticals in wastewater systems, Environmental Modelling & Software 62, 1-16.

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